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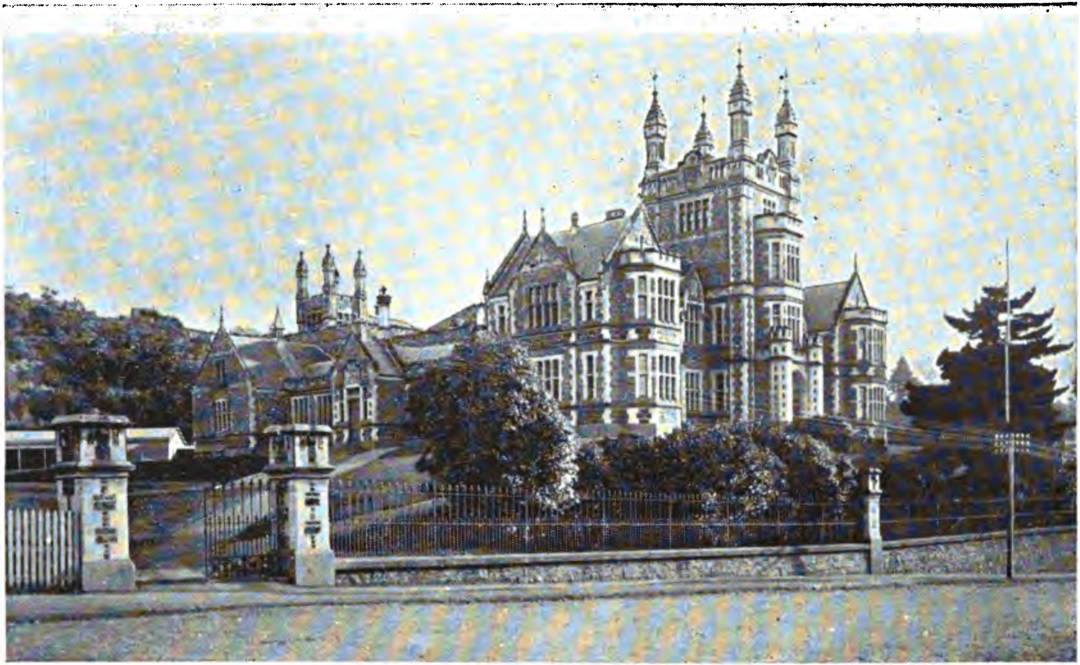

THE OTAGO BOYS' HIGH SCHOOL.

Lent by the Governors for the Association's Meetings.

DUNEDIN

AND ITS NEIGHBOURHOOD.

A SHORT ACCOUNT OF ITS HISTORY, BIOLOGY,
AND GEOLOGY; AND OF THE COMMERCE
AND INDUSTRIES OF OTAGO.

A HANDBOOK FOR THE USE OF MEMBERS OF THE AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

DUNEDIN MEETING, 1904.

Edited by A. BATHGATE.

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HISTORY OF DUNEDIN.

BY A. BATHGATE.

Little is known of the history of Dunedin and its neighbourhood before the coming of the white man, and it is improbable that the native population of the district was ever large, though there appears to have been some settlement of a more or less permanent character at Otepoti, the beach which lay where the post office now stands, extending thence along the shore to the mouth of the Water of Leith, and even beyond it to Pelichet Bay, where some hundred and fifty years ago a chief named Poho had his residence, of whom nothing is known, but whose memory lingers in the name of the pleasant suburb of Opoho. Tradition tells of a large pa called Puketai, across the harbour near Anderson's Bay, whilst many generations ago a bloody battle is said to have been fought at Taputakinoi, near Halfway Bush. The Maori population of the Middle Island was never so dense as in the North, and more than once it was almost exterminated by northern invaders. The last of these conquests which affected Otago was that undertaken by the Ngaitahu tribe, which displaced the Ngatimamoe. The occupation of the Middle Island by the Ngaitahu is computed to have begun towards the end of the seventeenth century, and it gradually extended southwards. The final overthrow of the last of the Ngatimamoe, which took place at Teihoka, on the Aparima River, in Southland, probably did not occur very long before the advent of the adventurous whalers. Almost all the surviving natives are descendants of the former tribe.

The establishment of whaling stations along our coasts must have wrought a change in the habits of the Maori, as they were attracted thither in the hope of gleaning some crumbs of the marvellous wealth of the white man. But not as beggars went the Maori; they would share with the pakeha the perils of the whaleboat, and many of them became expert harpooners; they would barter pigs and potatoes—both benefactions bestowed by Captain Cook—for the tomahawks, muskets, or blankets of the whalers; they would even at times take what they wanted with the strong hand, but to begging or petty theft they never stooped, for as a race the Maoris were Nature's gentlemen. Early in 1836 the population at Otakou, now Otago Heads, numbered between two and three thousand, while along the coast northward there was another settlement of some 500 natives at Purakanui; but none were resident at the head of the harbour, where the fair city of Dunedin now stands.

Though Maori traditions relating to Dunedin and its immediate vicinity are lacking, there are stories of two events which occurred in its neighbourhood that are worthy of recital. The traveller by the train northwards may see from the carriage windows shortly after leaving Purakanui station a green and picturesque little peninsula looking like an islet lying close to the shore of Purakanui Bay. Clothed with verdure, and bearing on its slopes a cabbage-tree or two, there is nothing to suggest the tragedy of which it was once the scene. Yet those green slopes once ran red with blood, and the yells of the victors and vanquished could have been heard above the noise of the surf that laves its rocky base. Some six generations ago a chief named Taonga, then living with his people farther north, paid a friendly visit to the tribe at

Purakanui, whose chieftains (Te Wera and Patuki) were nearly related to the visitor. Taonga, a domineering man, offended his hosts, and in revenge Te Wera killed a woman belonging to the v isiting party; but as this did not suffice to wipe out the real or fancied insult under which he was smarting, he secretly set sail with a number of his followers for Oamaru, where he fell on Taonga's people, and slaughtered several of them. Taonga, on learning what had occurred, returned to his home, and, raising a large war party, came back to Purakanui, thirsting for the blood of his foemen. The Purakanui natives retired on their approach to the little peninsula, which was then occupied by a strongly-fortified pa named Mapoutahi. Some days passed without hostilities, for both the invaders and defenders were wary. It was in the winter, and a snowstorm coming on, Taonga hoped the hour for revenge had come. When all was quiet within the pa he sent out a scout to ascertain if the palisade were guarded. The messenger returned with the intelligence that he had seen a sentry on guard. Not satisfied, Taonga sallied out to investigate for himself, and, creeping cautiously to the palisade, he found that the supposed watchman was nothing but a sham figure suspended from a post, so that it was blown to and fro by every gust of the wintry blast. Returning to his men, he imparted his news, and ordered them to silently follow. The palisade was soon scaled, and the invaders distributed amongst the whares when the war cry roused the inhabitants from their slumbers. Dazed by sleep they rushed from their huts, to fall victims to the weapons of the enemy. Only one or two escaped by leaping into the sea, and when morning dawned it disclosed the dead lying in heaps. From this the name Purakanui (heaped up) was bestowed on the locality by the victors.

The second tradition, while equally tragic, has more elements of romance. Its scene is a projecting rocky promontory overlooking the lower reaches of the Taieri River, which is known as the Maori Leap. The story is told by the Rev. J. W. Stack in his paper "The Traditional History of the South Island Maoris," published in Volume X of the New Zealand Institute Transactions. After telling of a tribal fight he says:—"Tukiauau, who escaped with his son and a few followers, separated from the main body of the fugitives and went down to the Waihora (now Waihola) Lake, where he built a pa. While there his son, Koroko Whiti, made the acquaintance of Haki Te Kura, the daughter of a chief whose pa stood at the mouth of the Taiari (Taieri). This maiden, unknown to her friends, used to meet her lover on the sands when the tide was low, and these clandestine meetings continued up to the time of Tukiauau's departure further south; for, hearing rumours of Ngai Tahu's movements, he became alarmed, and determined to place himself beyond pursuit. Accordingly he abandoned his pa at Waihora, and embarked with his followers in a large war canoe. As they were passing below her father's pa, Haki Te Kura, eager to join her lover, jumped off the cliff into the water, but in doing so either fell upon a rock, or on the edge of the canoe, and was killed. Tu Wiri Roa, overwhelmed with grief and rage, swore to destroy the man who was the cause of his daughter's death. Waiting till any suspicions Tukiauau's party may have entertained were lulled, the bereaved chieftain followed down the coast, and coming up with the fugitives, took them by surprise, and slaughtered Koroko Whiti and his companions."

If there was but little romance connected with the doings of the earliest inhabitants of Dunedin, there was even less surrounding the first British settlers. The end of the eighteenth and the earlier years of the nineteenth century witnessed the birth of several colonising companies, such as the Canada Company, with which John Galt, the author of "The Annals of the Parish," and many other works famous in their day, was closely connected. and amongst others the New Zealand Company came into existence, mainly through the efforts of Edward Gibbon Wakefield. A period of severe depression in trade in the British Isles had turned the thoughts of many able and far-seeing men towards emigration and the founding and peopling of colonies across the seas as a relief to the congestion of population in the old lands. Their ideals may be gathered from the toast, "Ships, Colonies, and Commerce," proposed by Sir Archibald Alison, the historian, at a banquet in Glasgow on the occasion of the sailing in 1839 of a vessel with emigrants for Wellington. The Company founded the settlements of Wellington, Nelson, and New Plymouth; but experience had evidenced a lack of organisation and attention to detail, which gave rise to difficulties. This led Mr George Rennie, a gentleman of Scottish birth resident in London, and who had sat in the House of Commons as member for Ipswich, to address a letter to the directors of the New Zealand Company, formulating a scheme for founding a settlement on a site to be situated on the East Coast of the Middle Island of New Zealand. A correspondence ensued, which was published in the Colonial Gazette and the New Zealand Journal, periodicals then published in England to further colonisation schemes. Mr Rennie's proposals were severely criticised, and he met with but little success or encouragement in his enterprise. But the controversy attracted the attention of Captain William Cargill, a retired Peninsular veteran, a descendant of Donald Cargill, the well-known covenanter, who had become imbued with the prevalent ideas regarding colonisation. Captain Cargill made the acquaintance of Mr Rennie, and in 1843, when certain difficulties which had arisen between the Colonial Office and the Company regarding the latter's title to the lands to be occupied were overcome, Mr Rennie and Captain Cargill approached the directors with a modified scheme on Mr Rennie's lines. Their proposal was that a Scottish Presbyterian settlement should be formed with a town to be called New Edinburgh. The details of the scheme need not be given here, but it may be mentioned that the block of land to be selected for the settlement was to be surveyed into town, suburban, and rural lots, and that intending emigrants were to be allowed to purchase one lot of each character for the sum of £120, the priority of selection being determined by lot. Certain lands were to be reserved for the Company, and also other lots as a municipal endowment, while a fourth of the proceeds of the sales went to the Company, half was to be devoted to emigration, and the remaining fourth was to be applied in a fixed ratio to defray the cost of surveys and other expenses, the construction of roads, bridges, and public improvements, and building of schools and churches, and in making provision for the payment of ministers and schoolmasters. The reply received from the directors was favourable, and Captain Cargill brought the scheme before the then recently formed Free Church of Scotland. The proposal met with a hearty approval at the hands of the committee of the Church, but much remained to be done, and more than four years elapsed before the first emigrants sailed towards the end of 1847.

During the intervening years the Otago Association had been founded in Scotland, and after many difficulties and lengthy negotiations an agreement was entered into with the New Zealand Company for the purchase of the Otago block on terms almost identical with Captain Cargill's first proposal. In the colony the selection of the site for the settlement was entrusted to Mr Frederick Tuckett, who, sailing from Nelson in a brigantine of 121 tons called the Deborah, examined the country from Banks Peninsula to Foveaux Strait, and finally fixed upon the lands from Otakou (now Otago Heads) to the River Molyneux as the most eligible for the purpose, and after negotiations with the Maori concluded an agreement with the leading chiefs for the purchase of the block selected, excepting certain portions which were reserved by the natives, for the sum of £2400. The only memory of Mr Tuckett's mission remaining is to be found in the name of Deborah Bay, an indentation in the shores of the lower harbour below Port Chalmers, which takes its name from his little craft. The Deborah returned to Wellington, leaving Mr Tuckett in possession, and brought back Colonel Wakefield and other officers of the Company, who approved of the selection, and completed the purchase by preparing a deed conveying the block of 400,000 acres which was executed by the Maoris, who received payment of the price in cash, a medium of exchange the value of which the natives had already learned in their dealings with the whalers. The survey of the block was commenced without delay, at first under the charge of Mr Tuckett, and later of Mr Charles H. Kettle. News of the proposed new settlement attracted a few white men from other parts of New Zealand, and these, the surveyors, and a few runaway sailors formed the first white inhabitants of Dunedin. But matters had not progressed so quickly in the Old Country as in the colony, and Mr Kettle in July, 1847, wrote to Colonel Wakefield: "Dunedin is now almost deserted, there being only five houses in the town inhabitated, and we have for the present almost given up hopes of the arrival of the settlers." The proposed name of New Edinburgh for our city had fortunately been abandoned by this time owing to the happy suggestion of Mr William Chambers, the well-known publisher, who protested against the barbarity of the intended name for the future Edinburgh of the South, and proposed the adoption of the Celtic name of the northern city instead. A link with these early surveyors is still to be found in the name of the hill behind the city which continues to be known as Flagstaff, from the fact that on its summit was fixed their first trigonometrical station, where flew their survey flag.

The first ship to sail was the Philip Laing, a barque of 547 tons, which left the Clyde on the 23rd November with 247 emigrants, under the charge of the Rev. Thomas Burns, a nephew of Scotland's national bard, who had been appointed first minister to the infant settlement. The following day the John Wickliffe, 662 tons, sailed from Gravesend, carrying Captain Cargill and 97 emigrants.

The John Wickliffe arrived at her destined haven on the 22nd March, 1848, and moved up to Koputai—which had been christened Port Chalmers after the great leader of the Disruption—on the following day, the 23rd, which has consequently been recognised as the date of the foundation of the settlement, an event still commemorated by a holiday on Anniversary Day. The Philip Laing arrived on the 15th of the following month with the larger number of the pioneers, and the work of settlement was fairly begun. Three other ships arrived during the year, and by the end of 1848 the infant city contained some 500 inhabitants, and by that time considerable progress had been made in divers directions, amongst others the establishment of a newspaper may be mentioned; and as an indication of the hopeful spirit which animated the small band of settlers its motto may be quoted: "There's pippins and cheese to come." Neither the Otago News nor its enterprising proprietor, however, lived to see the advent of the promised good things.

In those days both sides of Otago Harbour were clothed with dense bush down to the water's edge; the now fertile Taieri Plain was a swamp; but the enterprising settlers commenced the cultivation of the open lands to the south, some pushing their way as far as the Tokomairiro Plains and the valley of the Clutha River now generally designated the Molyneux. The only memory of the forest-covering of the harbour hills besides a few patches of the lighter bush which still linger her and there is to be found in the name of the railway station—Sawyers' Bay—on the Port line, for there the first saw pit was established, and many of the noble pines which then grew in the adjacent valley were converted into lumber for the erection of dwellings in Dunedin. The condition of the Taieri Plain is sometimes recalled when an old inhabitant points out a farm standing high up on Saddle Hill, overlooking the Plain, and supplies the information that it was the selection of the first settler, who preferred that location to the then swampy, but splendidly fertile, lands lying below. The old settlers experienced many hardships such as fall to the lot of the pioneers of settlement in any new country. But on the whole they enjoyed the life, and faced their difficulties manfully and hopefully. As an instance of their tribulations the misfortunes of one who ultimately became a successful farmer in a large way may be given. He had made his selection in Halfway Bush district, and after much toil had cleared it of flax and scrub, and broken up a portion, which he sowed with wheat. His money was becoming exhausted, and he looked forward to reaping the reward of his labours with his harvest. But though he managed to reap his crop successfully, his difficulties were not at an end, for while it was yet in the stook a spell of wet, mild weather came on, and to his dismay the grain began to sprout in the ear. When the weather cleared he dried his sheaves, threshed them with a flail, and conveyed his damaged grain to the mill, which had not long been established. It was duly ground, and the flour transferred to the warehouse of Johnny Jones, an old whaler whose whaling station was at Waikouaiti before the foundation of the settlement, but who was now established as a merchant in Dunedin. In the hope that he would shortly receive the price of his flour the anxious settler awaited the result in his hut at Halfway Bush, but on coming to town to receive, as he expected, his money, he was greeted with a request to take away the stuff, as it was not flour, but had set into something as hard as a brick. He was able to purchase seed for his next year's crop, but he had nothing to live on while it grew, and where every man did his own work there was but a scanty demand for labour. So he carried his flour back to where it was grown, broke it into pieces with a tomahawk, reground it in a coffee mill, and lived on damper baked from it and pork from wild pigs which he hunted on the neighbouring hills till his next crop matured. This he fortunately saved in good condition, and so took the first step in his ultimately successful career. Prosaic though such experiences may have been, they proved that the early settlers were hardy, courageous men, who could plod undauntedly on, and to whose efforts much is owing by the present generation. With varying fortune, for even in those early days the cry of the unemployed was at times heard in the land, the settlement steadily progressed; nor were the lives of the pioneers an unbroken round of toil, for even during the first year cricket matches were held, and the first Anniversary Day was celebrated by the holding of sports and races. A circulating library was opened little more than a year after the arrival of the first ships, so that those so inclined might thence derive instruction or amusement. It may seem surprising that races should have been inaugurated at such an early date in a community of staid God-fearing Scots, who just before the Philip Laing set sail found expression for their mingled feelings by holding Divine service on board, and singing the oft-sung words of the paraphrase—

O God of Bethel, by whose hand
Thy people still are led,
Who through this weary pilgrimage
Hast all our fathers led—

words which had a new and fuller meaning for them. But though the bulk of the settlers were Free Kirk Presbyterians, there was a leaven of Englishmen and others who did not see eye to eye with the majority. It was probably owing to this influence that the racecourse was so soon introduced, but in this particular departure they must have received considerable support from some amongst the Scottish settlers. This section of the community was dubbed "The little enemy"; bickerings and squabbles between the two parties were not unknown, and probably served to enliven and add zest to existence. As early as January, 1849, an English service was held in the gaol, the only building available, in which it continued to be held for some two years or more. That this strange accommodation was available is explained by the fact that up to the end of 1850 there had been only one criminal case since the arrival of the first ship. Indeed, up to the advent of the gold-seekers, the office of gaoler was well-nigh a sinecure. His prisoners consisted chiefly of runaway sailors, and the gaoler was more of a father than a gaoler to them. On their return to port they would pay him a friendly call. This may be understood and his methods appreciated when the story is recalled of his letting his prisoners go to the races and telling them they must be home early or they would be locked out. Up to the time of the gold rush locks and keys were useless throughout the settlement. But these days of Arcadian simplicity were destined to be rudely dispelled. In the winter of 1861 gold was discovered by Gabriel Read at Tuapeka, and all sorts and conditions of men flocked to Otago. Some of the early settlers caught the gold fever, and went off to the diggings, but many of them were unable to understand the change thus suddenly brought. Sixteen thousand people landed in Dunedin within the short space of three months, and as a consequence everything went up to famine prices. Property rose by leaps and bounds, and one shopkeeper who had his place of business near the head of Jetty street was startled by a smart Victorian walking into his store and offering him what he deemed a fabulous price for his premises; but instead of accepting the proferred price, he indignantly ordered the eager buyer out of the shop, as he said he could not have come by his money honestly. A minister in Dunedin at the beginning of what seemed to him the incursion of an army of barbarians, in the course of a prayer in church offered up a petition that the influx of rogues and vagabonds might be stayed. The bustling newcomers laughed at the staid, slow-going ways of the Otagans, whom they dubbed "old identities." The phrase owed its origin to a speech made by Mr E. B. Cargill in the Provincial Council, a local parliament which had been established under "The New Zealand Constitution Act" some ten years before, and which did much good work till the provincial form of Government was abolished in 1875 by an act brought into the General Assembly by Sir Julius Vogel. Mr Cargill in the course of the speech referred to made use of the phrase that he anticipated that the original settlers would preserve their "old identity." Thatcher, a singer of comic topical songs, immensely popular with the diggers, caught up the expression, and immediately produced a song to a catchy tune dealing with it.

Touch not that shaky jetty,
  Let that old post office be;
That's one way to preserve
  Your old identity,

he sang amidst the roars of laughter from his audience, and the old settlers were thereupon nicknamed "The old identities." The latter retaliated by styling the new arrivals "The new iniquity,' but while that name has long disappeared, the other has become classic, and though originally a term of reproach, has become an honoured designation. An Early Settlers' Association was formed at the Jubilee of the Province in 1898 of the settlers and their descendants who were here before the discovery of the gold, but it was found that the line of demarcation excluded many who were truly pioneers, and it has been deemed advisable to fix a more recent date of arrival as the qualification for membership.

Up to this time things were in many ways very primitive; some road formation had been done, but most of the country roads, as well as Dunedin streets, were unmetalled, and it was no unusual thing for ladies to go to an evening party on a bullock sledge or dray, while the men wore knee boots, and even leading citizens found a blue jumper not merely a serviceable but even a fashionable garment. The new conditions wrought a speedy change. The Provincial Government made good metalled roads to the goldfields, and the cost of carriage of goods, which had been £100 a ton, speedily fell; while the Dunedin Town Board vigorously prosecuted the formation of the streets, and in September, 1862, the streets were first lit with gas, though in the suburbs, which were then coming into being, and even in the outlying portions of the city itself, the wary traveller after dark usually armed himself with a colonial lantern, as was styled a clear glass bottle with the bottom removed and a candle dropped into the neck, which formed the handle. The discoveries of gold at Tuapeka and Waitahuna were quickly followed by similar finds in other localities; but the Victorian diggers, unused to the rigours of of an Otago winter, were beginning to leave the colony, when the auriferous deposits of the Molyneux River were disclosed by Hartley and Riley, who, in August, 1862, returned to Dunedin with 87 pounds weight of gold; and though at first reticent as to the locality of the discovery, disclosed it on the Provincial Government entering into an agreement to pay them £2000 on condition that 16,000 ounces were won from the field in three months. Other discoveries followed, the most important of which were those known as Fox's at the Arrow and the Shotover, both of which were rich fields. One party of five men at the Arrow gained 110 pounds weight of gold in a day or two over four weeks, or something over £1000 a man for their month's work, and such results were not uncommon. All engaged in the pursuit of gold were not "lucky diggers," and while many did well, and some splendidly, there were many who did not do more than, in miner's phraseology, "make tucker."

By the end of 1863 the tide had turned, and many of the miners and others drifted away to Victoria, some carrying with them their gains, while others took little away beyond their disappointed hopes. A year or two later gold was discovered on the West Coast at Hokitika, and a rush from the Otago goldfields took place. This, with the reaction consequent on the overtrading, induced by the excitement attendant on the gold discoveries, led to "bad times" commercially in Dunedin. For a time our merchants shared the trade of the West Coast goldfields, but the Melbourne merchants secured the larger portion of it. Owing to the expansion of business consequent upon the large permanent addition to the population of the province, Dunedin had become the most important centre of trade in the colony, and was for many years its chief distributing emporium. The introduction of Sir Julius Vogel's Immigration and Public Works Policy in 1870 gave a new fillip to business, and while the borrowed millions were being expended the colony generally experienced a tide of prosperity. This arose not merely from the large expenditure of public money, but was partly due to the fact that our chief products—wool and grain—were bringing good prices. Unfortunately, when some years later a halt was called in the public works expenditure, the prices of those commodities fell. The result was a period of depression throughout the colony, which was intensified in Dunedin by the loss of its distributing trade. The advent of steamers in the carrying trade between London and the colony, which carried a larger cargo than was required at any one port, and the much better harbour at Wellington, led to that port, with its commanding central position, wresting much of its former business from Dunedin, if not from Dunedin merchants, many of whom opened places of business in the capital. During this period of depression Dunedin, in common with other parts of the colony, lost considerably in population, chiefly of the artisan class, who were attracted to Australia by the better times then prevailing there. But throughout the years of depression the settlement of the country progressed steadily, while the city made little or no progress; but the balance between town and country has been restored, and for the last few years Dunedin has been growing, and if progress has been slow, there has been a constant advance. When it is borne in mind that it is not much more than half a century since the first settlers landed on these shores, the inhabitants of Dunedin have every reason to be proud of the work which they and their fathers have accomplished, as they well may be of the natural beauties which surround the yet infant city in which their lot has been cast.

NOTES ON THE SOUTHERN MAORI.

By A. Hamilton.

In the olden time the South Island of New Zealand was known as Te Wai Pounamu, Mohua, Aopawa, and sometimes as Tumuki, and the particular portion now known as Otago and Southland as Murihiku.

Much as we should like to know the history of the southern part of New Zealand in the olden time, it is certain that we can only get a very incomplete idea of the manners and customs of the people who have passed away and have left the traces of their occupation of the land in the shape of huge accumulations of shells, fish bones, and other relics of their hearths and homes. One tradition states that a people known as the Ngati-Mamoe were the original *tangata whenua* or people of the soil. There are still some natives who claim descent from these ancient people, but the majority of the Maoris who held possession of the district south of the Waitaki during the last century were descended from the more war-like men of the north of the Ngai Tahu tribe, who crossed the Strait and found an easy prey in the peaceful dwellers in the south. If we go back still further to the very earliest shadowy traditions and the fragments of genealogies that have been preserved, we find the very first people spoken of as inhabiting the South Island are the Kahui Tipua, a tribe of whom many weird tales are tōld, and who are generally classed as supernatural beings, hence their name—Te

Kahui Tipua—the Band of Ogres. After these fearsome creatures, one of whom had a pack of ten two-headed dogs, came Te Rapuwai, of whom also but little is known, but in whose time it is said that the moa was exterminated, and the fire of Tamatea spread over the land destroying the forests of Otago and Canterbury.

Although the above are generally regarded as semi-mythical traditions, it is probable that they contain elements of truth, and that Te Kahui Tipua and Te Rapuwai were early migrations of the aborigines of the North Island. The next tribe of whom we hear in the South Island were the Waitaha. The genealogies of these people show them to have been descended from one Rakaihaitu, who came to New Zealand in the Uruao Canoe some 43 generations ago (as against 19 to 22 generations of the ordinary Maori genealogies). Traditions attribute to these people a profound knowledge of *Karakia* (incantations) and of the science of navigation. The Waitaha after a long sojourn in the south were practically destroyed as a people by the Ngati-Mamoe, who were also an aboriginal tribe, and the last of the *tangata whenua* who held possession of the south of the North Island and the northern part of the South in the neighbourhood of Cook Strait.

So far as we know from the evidence available, a large Maori population inhabited Otago and Southland, and even in the wild and wet West Coast Sounds Cook found a few inhabitants. The evidence of the whalers and of the first settlers shows that in the first half of the last century there were settlements more or less permanent along the whole of the coast line, and that in the immediate neighbourhood of the Otago Heads there was a native population of three or four thousand persons. Various causes, such as the change in the kind of clothes worn by both sexes, virulent epidemics of smallpox and measles, and change in mode of living rapidly destroyed the population, and now we find only a few scattered families at widely separated intervals.

There are several questions connected with the early inhabitants that can now only be settled by the examination of the sites of villages, which have been abandoned or destroyed and then covered by the drifting sand. The question of most general interest is, perhaps, did the Maori and the moa exist together or had the moa disappeared as a living bird before there were any inhabitants in this part of New Zealand.

From Shag Point to Preservation Inlet, in every bay and inlet traces can be found of middens or refuse heaps, and the disturbance and destruction of the vegetation on the inner lines of sandhills by cattle and by human traffic has resulted in the removal of sand which has covered ancient sites for hundreds of years, and of which no tradition remains among the natives who have lived in the neighbourhood for generations.

In other places, such as those at Tautuku and Catlin's River, the age of the deposits is certainly great by reason of the size of the forest trees which have grown over the heaps of shells and bones disclosed by the erosion of rivers or by man in the process of clearing the land. These middens and village sites along the coast have afforded a very large quantity of implements and relics of stone and bone, and from these can be deduced a good deal of information as to the daily life of the natives. Along certain well-defined tracks to certain districts in the interior may also be found relics indicating more or less permanent settlements in the neighbourhood of tribal hunting grounds.

Much has been written on the question of the moa, but the evidence of the very old middens at Shag Point indicates unmistakably that at the time when the earliest settlement took place there a large part of the food supply of the inhabitants of that Kainga was derived from moas, of the genus Pachyornis. In support of this statement I may state that Mr F. R. Chapman (now Judge Chapman) and myself made some excavations at this settlement some years ago, in the course of which we found between 50 and 60 necks of these moas, in most cases with the skull attached. The only other bones found were some of the tibiæ, and these were all broken. The position and composition of the midden was such as to preclude any other conclusion than that the heads and necks had been thrown on the rubbish heap as useless for food purposes.

We may therefore conclude that the early inhabitants were moa hunters, and assisted in the disappearance of one of the most remarkable of the forms of bird life. In every midden yet explored traces of the extensive use of bones of the moa for fish-hooks, pins, etc., can be found, but none of these would prove that the natives had hunted the bird.

From the middens we also find evidence that the tuatara lizard (Sphenodon), now extinct on the main land, was not uncommon, and at several places such as Warrington and Long Beach bones of the extinct notornis and an extinct swan are not uncommon.

Another question is as to the early use of greenstone. It was formerly stated that greenstone was not known to the earliest inhabitants. It is certainly very much more scarce in the older settlements, but at Shag Point a worked piece of greenstone was found in the very lowest layers, and I see no reason to doubt that the use of such a hard and beautiful stone was soon recognised by the experts of the Maori stone age.

Large collections of stone adzes, fish-hooks, flints, and ornaments of all kinds have been made by collectors on the sites of old villages which formerly existed on the sandhills in the bays near Dunedin. One of the most famous localities was a very small bay called Murdering Beach. This seems to have been a dwelling place of chiefs rich in greenstone ornaments, as large numbers of beautiful specimens have been dug up there. Another place which has yielded fine specimens is Papanui Inlet on the Peninsula. The islands in Foveaux Strait have at one time had a large population, and no doubt a large number of interesting relics will some day be found and will help us to realise more vividly the genius, industry, and perseverance of the finest race of savages of the Southern Hemisphere.

The more peaceful habits of the southern Maori did not necessitate the construction of the great fortified pahs with ditches and banks seen on almost every hill top in the North Island, but tradition states that there were fighting pahs at Puketeraki, Purakanui, the Heads, and in a few other places.

The south is, however, not without its traditions of war, and at Tuturau, near Mataura, was fought the last great battle which took place in this part. In 1836, at the time of the raids of Rauparaha on the Kaiapoi people, one of his fighting chiefs, Te Puoho, crossed the Haast Pass and entered Otago by the head of Lake Wanaka with a considerable band of men. They captured or killed the whole of the Wanaka natives, and would have served those of Hawea the same way, but a lad escaped and got away to Hawea, when he warned his tribe, all of whom fled down the Waitaki to the coast. An old native just dead (Rawhiri Te Maire) was one of these fugitives. Te Puoho carried his captives right down through Central Otago, crossing the mountains to the present site of Kingston and passing down the Mataura Valley to Tuturau, where he was killed by Topi of Ruapuke and his party destroyed.

Then, again, local history is full of the great deeds of Te Wera of Puketeraki and of the Ngai-Tahu chief, Tara-whai, whose bravery was most extraordinary.

One incident in the career of Tara-whai is worth mentioning. By treachery his party of men were killed in an ambuscade; the chief, however, was made prisoner after a desperate struggle. As Tara-whai had been a scourge to these Ngati-Mamoe they were determined to cut him to pieces alive. He was accordingly laid on his back on the ground and a native began to cut open his breast with a sharp stone. The attention of those holding Tare-whai being directed at that moment to some strangers who were arriving at the pah, he, noticing their inattention, sprang to his feet and succeeded in making his escape into the bush. Being much distressed at the loss of his favourite war club made of whalebone, he determined to attempt its recovery, and accordingly took advantage of the shades of evening to approach the camp of the Ngati-Mamoe. Arriving near the place, he noticed a number of natives seated near the fire. Drawing near he saw them examining his lost weapon and talking of the bravery of its owner. Noticing the absence of a Ngati-Mamoe who had a defect in his speech, he walked up to the outer circle and seated himself on the ground, asked (feigning the voice of the man of defective speech) to be allowed to look at the celebrated weapon. It was handed to him by the unsuspecting Ngati-Mamoe, when, jumping suddenly up, he struck the two nearest to him on the head with the weapon exclaiming, "The brave Tara-whai has recovered his weapon," which so astonished his enemies that before they had recovered from their surprise he had disappeared into the darkness. After several other adventures he safely regained the shelter of his own fortified pah.

Of local names which commemorate incidents and persons of a by-gone day there are many, and it would appear that almost every physical feature, mountain, river, headland, bay, or rock was known to the Maori by its proper name.

As an example let us take the group of septarian boulders washed out of the greensand cliffs near Moeraki, and widely known by photographers and sketchers as Moeraki Boulders.

According to Maori ideas and tradition this was the scene of the loss of the Arai-te-uru, wrecked here on a voyage to the south in search of the precious stone of Te Wai Pounamu. The reef which extends seaward near the Shag Point represents the petrified hull of Arai-te-uru. After braving the perils of the great ocean of Kiwa and the stormy waters of Raukawa or Cooks Strait, she here lies on her side with the empty hollow of her hull facing towards the mainland, while close to her in the shape of a prominent rock stands the petrified body of her commander. Strewed along the beach are some of these huge boulders representing Hinaki or eel-basket of Hape-ki-taurake and the slave Puketapu. The more globular septarian boulders are the calabashes which held the supply of water for those in the canoe, and a number of strangely-shaped irregular concretion further along the shore are the Kumaras (sweet potatoes) washed ashore from the wreck. Evidently some of the crew reached land safely, for the surrounding hills bear their names. Towards the south lie two twin hills, Nga tamariki a Hekura (the children of Hekura) and Puketapu, who, whilst gathering fire-wood, were overtaken and surprised by the dawn, and turned into hills. To the north of these stands Pakihiwitahi (the one shouldered), with his face to the south and his single arm extended waiting in vain for the reurn of Puketapu and the children of Hekura.

A story of the present century tells of the destruction of the chief settlement near the Otago Heads. About 1817 the piece of flat land on the Peninsula, about a mile from the Heads, was covered with a large and populous Maori village of about 600 houses. There were also thriving settlements at Kaikai Beach (Takeretawhai), Murdering Beach, and Long Beach (Wharauwerawera). Whale fishing was then at its best, and numerous vessels from Van Dieman's Land and Australia sailed these southern seas, and called occasionally at what is now the Otago Harbour (then known as Port Daniel) or Waikouaiti, and other anchorages on the coast. A vessel named the Sophia cast anchor one day just inside the Heads, and a boat put off with seven men and went to Murdering Beach (Whareakeake) to interview a chief residing there, and to purchase some potatoes, which were even then grown by the natives in some parts. During the interview one of the sailors was recognised by a native as the man who had stolen a dried head from some Maoris near Riverton some years previously (1811),* and revenge was naturally sought without delay. After a hard fight four of the crew managed to regain the ship. They found about 150 natives on board, who soon heard of the disturbance and became excited and threatening in their behaviour, and at last, under direction of their chief, tried to take the crew prisoners. However, the large sealing knives carried by the whalers slew so many of the natives that a great number jumped overboard and were drowned in the swift current. The Maori chief was at last overpowered and bound. The account says: "We then threw overboard 16 bodies that were killed by the knives; the number who jumped overboard and were drowned must have been about 50, and as many were wounded in the fight." Only two of the crew were wounded. The article then goes on to say:—

"We kept a good watch during the night in case of being attacked by a large number of canoes that were drawn up on the beach in front of the town.

"The next morning about 6 o'clock a large number of natives were gathered round the canoes. We expected that they were going to make an attack on the brig, and that they thought that their chief was killed: they cried out often for him to come on shore. We tied his hands and let him come on deck. When they saw him there was great rejoicing. He called to them to bring a large canoe load of potatoes alongside, to pay us, as we thought, for his liberation. A canoe was launched off the beach, with two men to paddle her off to the brig. On the canoe nearing the vessel, one of the men that was stationed aft called out 'The canoe is full of men!' We all rushed aft, and saw the canoe had a large number of men lying in her bottom covered over with mats. Our firearms being all ready loaded, lying on the deck, we lifted them and fired a volley into her. The natives, who were all armed with short spears and clubs, jumped over the sides of the canoe, and tried to pull it alongside the brig. Had they succeeded, they must have boarded and taken the vessel in spite of all that we could do. There were nearly 40 of them and only 14 in all of our crew. Several of them were shot and run through with boarding-pikes in trying to get up the sides of the vessel. Corockar jumped overboard to get to the canoe, but was shot in the neck. Two of his men swam to him and took him on shore in a most gallant manner, but he died next morning of his wounds. Thus we had another narrow escape of being taken and murdered. We kept a good watch all night, expecting to be boarded and taken at daylight.

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*This was the first dried head offered for sale in Sydney. The account of this massacre is to be found in several old newspapers published in Tasmania and New Zealand, and has been given in detail in the Transactions N.Z. Inst., vol. 28, p. 141.

"Next morning, being the 24th of December, 1817, a great number of natives were on the beach making a great noise, seemingly lamenting and crying because of the death of their chief Corockar. They were preparing to launch their canoes. We thought they were coming off to try and take the brig, and thought it better to stop them if possible. We immediately manned our two boats, and, taking arms and ammunition, pulled close to the beach where the canoes were lying. It was thought most expedient to destroy all their navy at once, to prevent them from making the attempt. As soon as the boats came near the beach the natives all ran away over the bank. We landed one boat's crew, and kept the other boat afloat to cover the men on the beach with their muskets. We then commenced with two long cross-cut saws cutting the canoes up, each into three pieces. They were 42 in number, large and small, all of which we destroyed, and, as we wanted firewood, we split them up and took them on board. As soon as they saw all the canoes destroyed they rushed with clubs and spears up to their necks into the water trying to get hold of the boats, but they did not succeed in wounding any of our men.

"They having become more excited and inflexible at this attempt to seize our boats, we determined at once to land, set fire to the town and burn it to the ground. This was the 26th of December, 1817. It was a fine, clear summer day, blowing a fresh, hot wind from the north-west. We landed nine men, but kept the boats afloat. On our approach the natives all ran to the rising hills, and left us in full possession of the town. This town consisted of about 600 fine houses, and perhaps a finer town never was seen in any part of New Zealand. The fire was lighted at the weather end, and in about four hours the beautiful City of Otago, as we then called it, was laid in a heap of ashes. We now required fresh water for our sea stock. There were several fresh-water holes on the beach where the canoes were lying. We observed the water in those holes of a curious colour, and recollected that Tucker (the man who was killed by the natives for the theft of the dried head) had told us the natives were in the habit of poisoning the water if they expected their enemies were coming to invade them. On this information we declined taking or using any of the water. On the 27th of December, 1817, at daylight, we weighed our anchor and left Port Otago and sailed for Chatham Islands.

Hundreds of natives came down on the shore to see us off. We fired a volley of musketry towards them to say good-bye."

It must not be thought that in the South Island there was a continual state of warfare, and it is quite a mistake to suppose that the old Maori life in peaceful times was one of privation and suffering; on the contrary, it was a very pleasant state of existence; there was a variety and abundance of food and agreeable and healthy occupation for mind and body. Each season of the year and each part of the day had its specially-allotted work both for men and women. The women, besides such household duties as cooks and cleaning their houses, made the cloths and bedding required for their families. They gathered the flax and other fibres used and prepared, and worked them up into a great variety of garments, many of which were of a kind that took months to complete, and, when finished, were very beautiful specimens of workmanship. The men gathered the food and stored it in *whata* or storehouses built on tall posts to protect the contents from damp and rats. Besides such natural products of the soil as fern-root and other roots, they cultivated in the northern parts *kumara*, *taro*, *hue*, and *karaka*. Fish of various kinds were caught in the proper season and cured by drying in the sun. Wild pigeons, *kaka*, paradise ducks, and *titi* (mutton birds) were cooked and preserved in their own fat in vessels made from the kelp seaweed, bound round with *totara* bark to strengthen them. Netting, carving, grinding by friction, and fitting stone implements and weapons occupied the time of the old men and also much of the young men's time. They beguiled the winter evenings be reciting tales, myths, histories, traditions, and tribal genealogies, chanting and singing poetry, telling fairy tales, and per-forming dances. It was only when they became ill, and when harassed by their enemies that the ancient Maori can with any truth be said to have been miserable or unhappy. They delighted in war, so that the danger and fatigue on such occasions were more a delight than sorrow or weariness.

BOTANY OF DUNEDIN DISTRICT.

By Geo. M. Thomson, F.L.S., F.C.S.

Owing to the configuration of the land and the irregularity of its surface, the flora of Dunedin and its neighbourhood is of a very diversified character. Ranging from sea-level to a height of 2400 feet, examples of all zones of plant life from the littoral to the sub-alpine are represented by a total number of nearly 450 species of flowering plants and 72 vascular cryptogams. Besides these there are about 160 species of introduced flowering plants in the district. To most botanists this will seem a small number of species to find in such a diversified area, but it must be borne in mind that as compared with the whole of the New Zealand flora it is really a considerable proportion.

A wise forethought on the part of the founders of the Otago settlement set apart a wide strip of ground round the city as a Town Belt, and although all the heavy timber was cut out of this area half a century ago, so that very few representatives of the Coniferæ remain, yet there is to be found a very interesting and representative indigenous flora within a few minutes walk of any street in town. In most of the open parts of the Belt, introduced plants have disputed possession of the ground with the native flora; in some places the latter has been largely displaced, but in others it has successfully asserted itself. Two agencies, which in other parts of the country have exercised a great influence in this contest, have here not come into play; cattle and sheep have been carefully kept out of the Belt, and fires are rigidly suppressed. Indeed, this area furnishes an interesting example of the competition between the two opposing floras, the indigenous and the introduced, and where the ground has not been disturbed by man, the latter has not succeeded to any great extent in spreading, with, however, a few striking exceptions. These latter include some of the coarser and stronger grasses, especially Cocksfoot *(Dactylis glomerata)*, such plants as Broom and Gorse, which scatter their seeds by the bursting of their pods, and in the bush itself the Elderberry *(Sambucus nigra)*, which is being rapidly disseminated by blackbirds and thrushes, both of which are now extraordinarily abundant. But wherever roads or tracks have been cut and the ground disturbed, introduced species of plants have mainly taken possession of the soil.

With the steady increase of population, the cutting down of the forest which even in recent years extended right into the town boundaries, and the widening of the suburban area, there has been a steady outward advance of the introduced flora, and a consequent displacement of native plants.

Of the total number of indigenous flowering plants, nearly 400, or about eight-ninths of the whole, are endemic species; these belong to no less than 207 genera, of which, however, only 14 are endemic. While the majority of the local genera show Australian affinities, yet the facies of the flora is quite special. This would seem to show that these islands have been separated from other parts of the earth's surface for a sufficiently long time to enable the dominant plants to acquire a characteristic appearance.

The plants found in this area belonging to endemic genera are of interest enough to merit special notice. The Hina-hina—*Melicytus ramiflorus* (Nat. Ord. Violaceæ) is one of the commonest small trees in the Town Belt and in the neighbouring country. Its small yellowish flowers are produced in clusters along the branches in November and December, followed about February by purplish berries. Like all the plants of the order, it has some peculiar development of the stamens, in this genus taking the form of a nectariferous gland on the back of the filament, from which fact Forster derived the generic name, which he compounded from two Greek words meaning honey cavity. *Hoheria angustifolia* (Malvaceæ) is a graceful little tree common in many parts, characterised by its pretty star-like white blossoms which come out in the month of January. The name is a modification of the Maori name Houhere. *Pennantia corymbosa*, the only example in New Zealand of the large order of the Olacineæ, is another prettily-flowered shrub or small tree, which occurs somewhat sparingly in the district. As Hooker long ago pointed out, the development of the fruit is very peculiar, and has never been worked out. *Carmichælia flagelliformis* is the only representative here of a most singular genus of Leguminous plants. With a superficial resemblance to a broom, but with very small purplish or striped pea-like flowers, it has seed pods quite unlike those of any other group of papilionaceous plants. Most of the species are quite leafless in the adult stage, but when present, the leaflets are in one or two pairs only. *Carpodetus serratus* (Saxifrageæ) is the only species of the genus, which also received its name from Forster from its little round fruit which is surrounded by a cup-like calyx (Greek *Carpos*, a fruit; *detos*, bound). It is a very common little tree in the neighbourhood, and its small whitish flowers are usually in bloom in January.

Two endemic genera of Araliaceæ are represented in the district by three species. *Pseudopanax crassifolium*, commonly known as the Grass-tree, is met with abundantly; it furnishes excellent walking-sticks, and is much sought after for this purpose. Like all the closely allied plants, young specimens differ both in habit and in foliage from the adult trees. The other species of the genus —*P. ferox*—occurs more sparingly and only in portions of bush at no great distance from the sea coast; it receives its specific name from the coarse, thick almost spinose dentations of its long, narrow leaves. *Schefflera digitata* is a large tree with large digitate leaves having from 7 to 11 leaflets, and with large open umbels of very regular green unisexual flowers. The ten-celled ovary ripens in autumn into a black berry. *Corokia cotoneaster* (Corneæ) is a low-growing, much branched shrubs with black tortuous stems, and small leaves which are white on their underside. Its little flowers are also greyish-white on the outside of the calyx but golden yellow within, and they present a curious contrast to the branches which bear them; later in the season they are followed by small red drupes. *Tupeia antarctica* (Loranthaceæ) is the only species of a peculiar genus of Mistletoes. It is a very common parasite on several shrubs and trees, sometimes even on another common Mistleto —*Loranthus micranthus*. Like so many New Zealand flowering plants it is quite diœcious, but though its flowers are small, green, and inconspicuous, they are very fragrant and are freely visited by small Diptera.

The only endemic genus of Composites found here is *Raoulia*, most of the species of which are densely tufted alpine herbs. Some of these, with closely-packed branches bearing a flower-head at the tip, grow in large masses or hummocks on the mountain sides, and are popularly known as "Vegetable sheep." Their extremely compact growth and hardness of leaves and branches apparently served to protect them against the grasshoppers which formerly occurred in vast numbers in all open parts of the country, but which of late years have been very much reduced in abundance by the imported starlings. There are five species of *Raoulia* found in the neighbourhood of Dunedin, but they do not present the densely-packed appearance of the alpine forms. Like all the allied composites the colour of the flower-heads is entirely due to the encircling bracts.

The only other endemic genus which is commonly found here consists of two small epiphytic orchids *Earina mucronata* and *E. autumnalis.* The former, which blooms in midsummer, has panicles of small yellowish very fragrant flowers, while the latter is usually three months later, and has white blossoms. There is nothing very special in their mode of fertilisation, which appears only to depend on the depression of the pollinia by the act of pulling them out of anther case. Both are absolutely dependent on small insects for pollination. Perhaps the most characteristic indigenous plant is the well-known "New Zealand Flax," *Phormium tenax,* abundance of which is still to be found in the wild state. Its large dull red flowers contain considerable quantities of nectar, and were formerly fertilised by various species of birds (tuis, korimakos, and perhaps others). It has been suggested that the extreme toughness of its leaves served to protect it against the herbivorous moas; and it shares this character with so many of the commonest New Zealand tussock-grasses *(Danthonia, Poa,* etc.).

In the Town Belt are to be found many species which are of interest. Besides those already referred to, the following are among the commonest kinds of trees. *Fuchsia excorticata* is characterised by and receives its specific name from the papery bark which is readily stripped off the stems and branches. On peeling a piece of the stem, a curious feature is observable,—the sub-epidermal layer is found to contain chlorophyll, a character which does not seem to have been looked into. The plants are dimorphic, one kind bearing large purple or greenish-purple flowers, which are hermaphrodite in structure and function, and the other having much smaller pink or reddish flowers, which are also complete in structure, but have no pollen in their anthers. The pollen of all the New Zealand fuchsias is bright blue in colour, and coheres in masses by means of fine threads of viscine. The flowers are fertilised by korimakos or honey-birds *(Anthornis)* and tuis *(Prosthemadera)*. The Broadleaf *(Griselinia littoralis)* is one of the most picturesque trees of the bush, on account of the irregularity of its stem and branches, and the vivid green of its shining foliage. It is a diœcious species, with very small greenish-yellow flowers. The Pepper-tree *(Drimys axillaris)* is characterised by its purplish spotted leaves, which are almost lilac or grey underneath, and are extremely pungent in taste. Two species of *Pittosporum*, called respectively the Black Mapau *(P. tenuifolium)* and White Mapau *(P. eugenioides)* are among the commonest and the most prettily foliaged trees in the bush. They differ remarkably in their flowers, the former being nearly solitary and brownish-purple in colour; and the latter yellowish and occurring in umbels. Makomako *(Aristotelia racemosa)*, popularly known as the New Zealand Currant, is one of the few trees which bears deciduous leaves. In mild winters it retains its leaves, but in more severe seasons it becomes leafless, a character which it shares with the Fuchsia and the Ribbon-woods. Its rosy pink flowers have a curious regularity of structure, the four petals being each rather deeply three-lobed, and having inside them twelve stamens in four clusters of three each. and a four-lobed ovary. On the same tree one finds complete flowers, some absolutely staminate without a trace of a pistil, and others pistillate without any stamens. The large Ribbon-wood *(Plagianthus betulinus)* is very common, especially at the north end of the Belt and in the Botanical Gardens. It has small greenish inconspicuous flowers. Its relationship to *Hoheria* is shown by the curious similarity of its leaves when the plants are young, to those of its more elegantly-flowered ally. Tutu *(Coriaria ruscifolia)* is not so common now within the confines of the Belt as it formerly was, but may still be met with in patches of more open ground here and there. This is one of the most interesting of the native plants. It is one of the very few poisonous plants of the country, a feature which is inexplicable from a New Zealand point of view, where there was in former days nothing to be guarded against in this effective manner, but which is readily understood when the antiquity and the very wide geographical distribution of the genus is considered. Both this species and its mountain relative, *C. thymifolia*, occur in South America. The stems are more or less four-square in section and bear the leaves in opposite pairs at right angles to each other, but as each internode is slightly twisted, the leaves become two-ranked, and look like compound leaves with rows of leaflets. Then the flowers are completely guarded against self-fertilisation by being very strongly protogynous, the pistils maturing and withering before the stamens are ready to open. The flowers are wind-fertilised, having relatively large prominent stigmas and loosely-hung anthers which scatter out quantities of dry dusty pollen. The petals are reduced to a very rudimentary condition, but after the flowers have been fertilised, they commence to grow, and ultimately become fleshy and full of purple juice, forming the so-called berries. Altogether it is a most interesting plant. All the species of *Coriaria* are noted for the poisonous character of their juice, due to the presence (in the New Zealand species) of a glucoside named "tutin." This substance has been isolated and investigated by Professor Easterfield and Mr B. C. Aston, and is found to be intensely poisonous. In the early days of the colony, when pioneer settlers took up tracts of new country, and drove large mobs of cattle to the outlying districts, loss by "tutuing," as it was called, was not uncommon. Animals feed and fatten in tutu country, if they are not driven about; but when driven for a day and allowed to rest at night in such land, they are liable to be poisoned. The effect is to produce a species of intoxication or madness, to which some succumbed, while others lost their lives by drowning if near rivers, or falling over cliffs. Old stockmen had many tales to tell of their adventures with "tutued" cattle. The seeds contain the poison, but the purple juice of the fruit (petals) does not, and the Maoris used formerly to express this juice, carefully straining it from the seeds, and drink it.

Panax colensoi, sometimes termed the New Zealand Gum-tree from the large quantity of gummy matter which exudes from the bases of the young leaf-petioles, is a common tree, of a very ornamental character, on account of its large glossy digitate leaves. Its green flowers are produced in large open umbels; they are quite diœcious, nectariferous on the disc, and are fertilised by flies.

Among these trees and shrubs several climbing plants occur. Two species of *Clematis* are common. *C. foetida* with small leaflets and panicles of yellowish flowers, grows in open sunny places, such as the rocky slopes on the south side of Woodhaugh. It was most inappropriately named by Raoul, for its flowers are very fragrant and attractive to insects. *Clematis indivisa* is one of the finest species of the genus, and is common in all parts of the bush. It shares with so many other New Zealand flowering plants the peculiar diœcious character, the pistillate flowers retaining a ring of stamens, which, however, are functionless, being quite destitute of pollen.

Native brambles, all included by Hooker under one species, *Rubus australis*, are very abundant, especially on the edge of the bush, and are very formidable plants to get among. There are probably three or more distinct species, one of which—*R. cissoides* (of Allan Cunningham) has its leaves totally or nearly reduced to midribs. All furnish excellent examples of plants which climb by means of recurved hooks, and the curvature of the petioles and petiolules to aid in this device is very interesting at a little distance, but is most irritating when the hooks get hold of one's clothes or cuticle. The flowers of these brambles are quite diœcious.

Parsonsia albiflora is also a common climber, and is a most variable plant in its foliage. Its small white waxy flowers have a peculiar arrangement of the anthers such as is common to many plants of the order (Apocyneæ). The five anthers are joined together to form a small cone, each with an empty cell on the outside and a pollen-filled cell on the inside; and these close on the top of the style, over a minute velvety ring, below which—and quite secure from its own pollen, is placed the stigmatic surface, which is also ring-like. The long slender pods ripen about March, and split by two valves, scattering out two rows of seeds which are furnished with tufts of silky hairs, recalling the parachutes of the willow-seeds. The only other abundant climbing plant is *Muhlenbeckia adpressa* (Polygoneæ), which is equally common in parts of Australia and Tasmania. Its most prominent characteristic is the fleshy fruit (pseudocarp), formed of the persistent perianth lobes, which are no doubt attractive to fruit-eating birds. The number of succulent-fruited plants in New Zealand is relatively large, but one wonders at the defective taste of the native birds, for so few of these fruits seem to have any special qualities of sweetness or flavour to recommend them. Perhaps, however, the poor things could not help themselves, and like the human inhabitants of these islands in former times, had to put up with somewhat hard fare.

In the denser parts of the bush, Supplejack *(Rhipogonum scandens)* forms great rope-like lianas, whose leafage is mostly high up among the trees it climbs upon. Its stems, with knotted underground root-stocks, are much in demand for canes and walking-sticks. The Maoris formerly used the plant very extensively for many purposes.

In more open parts of the country many plants of interest are to be met with. Perhaps the commonest are the two species of *Leptospermum* or Manuka. One of these—*L. scoparium*—is a common Tasmanian and Australian plant, and is furnished with hard pungent leaves, evidently as a protection against grazing animals, though the New Zealand form (as we might expect) is not nearly so hard or rigid as its representative on the other side of the Tasman Sea. But the endemic species—*L. ericoides*—has not only developed a much smaller flower and fruit, but it has also lost the protective character of the leaves, these being rather small, soft and obtusely pointed. It is of interest in this connection to note that the very few spinously-protected plants which occur in these islands have a wide distribution outside of New Zealand, a feature which also applies to the two genera *Acœna* and *Uncinia*, which have hooked seeds to cling on to animals. The only apparent exception is shown by the umbelliferous genus *Aciphylla*, to which belong two formidable species of "Spear-grass." Though the genus also occurs on the Australian Alps, it is probable that the local species acquired their protective spines as a defence against Moas.

Conspicuous among the plants of the open scrubby ground are various species of *Coprosma*, one of the most typical of New Zealand genera. About thirteen species occur in the neighbourhood of Dunedin, some in the bush, others especially in the open. The latter are mostly tortuously-branched, small-leaved shrubs, but all abound in features of interest to the botanist. The leaves are furnished on the lower surface with curious open pits, protected by hairs, and the function of these cavities has not yet been discovered. The flowers are extremely inconspicuous in size and colour, but are strictly diœcious. The pendulous male flowers have four stamens hanging a good way out of the corolla, and the pollen is extremely light and dusty, so that it floats away on the lightest breath of wind. The female flowers have relatively very large protruded stigmas, so that they may catch some of these floating pollen grains. The fruit is a small drupe with two nuts, variously coloured yellow, orange, red, or bluish in the different species. Altogether it is a noteworthy genus of plants.

Species of *Olearia*, *Cassinia*, and *Gaultheria* occur in the open ground, with interesting forms of *Veronica*, *Astelia*, and others on the edge of the bush land.

The littoral flora can be well studied by a walk to the Ocean Beach and over Lawyer's Head to the Tomahawk Lagoon, a relic of one of the many small inlets which were formerly common along the coast, before the shore-line was raised to its present level. In the sandhills patches of pale green *Euphorbia glauca* occur, mixed with the hard culms of *Desmoschœnus spiralis*. This is a sedge of most curious habit, allied to *Isolepis* in its floral characters, but having its stems surrounded by harsh scabrid leafy bracts, among closely-packed spirally-grouped clusters of brown inflorescences. Growing close to the ground are such plants as the ubiquitous *Convolvulus soldanella*, its beautiful pale green kidney-shaped leaves setting off the purple striped flowers; *Pratia angulata*, a kind of white *Lobelia*; *Samolus littoralis*, a wide-spread species and the only representative of the Primulaceæ which occurs in New Zealand; and in damp ground the pretty little purple-flowered *Mimulus repens*. On the headlands, three species of *Pimelea* occur, *P. arenaria*, *P. virgata*, and the variable *P. prostrata*, all with small whitish flowers which simulate some kinds of *Veronica*. Among these are found the common coast species *Veronica elliptica*, one of the finest forms of this typical genus. Descending to the bed of the lagoon many interesting bog and aquatic plants are still to be met with, though the poaching of cattle has destroyed much of the original flora. Here is abundance of such sedges as *Scirpus triqueter*, *Eleocharis gracilis*, *Isolepis nodosa*, *I. riparia*, species of *Carex* and *Juncus*, mixed with *Triglochin triandrum*, while in the water itself are *Limosella aquatica*, *Ruppia maritima*, and other plants of similar character. The water of the lagoon, like all of its type, is brackish at the mouth. This used once to be one of the most interesting collecting grounds near Dunedin, but its day is past, and its beauty has given place to an appearance of desolation and mud. Only a few years ago it was surrounded by a fine bush, and its waters were clear and sparkling, but the clearing of the ground has dried up the little streams which formerly kept up its supply, and now when heavy rain does come on, mud and clay are washed into it in quantity, and it is silting up in all parts.

The sub-alpine flora found on the summit of Swampy Hill, which is only about five miles from the centre of the city, and which rises to a height of some 2300 feet, is of a very interesting character, though even here the hand of the "improver" has wrought much destruction, without securing any corresponding advantage worthy of the effort. This type of flora is more fully developed on the top of Maungatua (the Mountain of the Spirit or God), a fine bold range rising somewhat abruptly to a height of 3000 feet along the west side of the Taieri Plain, at a distance of some 20 miles from town; but it cannot readily be investigated in a one day's excursion.

The direct way, but by no means the easiest, to reach Swampy Hill, is up one of the tributary streams which flow into the Leith, such as Nichol's or Morrison's Creeks; but the glory of the former has been very much spoiled by the number of feet which have trodden out the delicate native vegetation, while the cutting away of the surrounding bush has completely destroyed the latter. The ravines cut out by these streams were formerly dreams of beauty. Every stone and tree-trunk was covered with a dense growth of filmy ferns, mosses and liver-worts of the most exquisites shades of green, among which nestled little orchids *(Corysanthes)* with tender kidney-shaped leaves and purple blossoms like long-legged spiders. Here, too, in the very splash of the running water were dainty wood-sorrels, their drooping white flowers thickly dotted among the pretty trefoil leaves. Under the dense fern growth on the slopes were mats of pale green *Nertera* creeping close to the ground, and covered in late summer with bright crimson berries. Truly had such profusion of vegetation been found in the older countries of the world, these wonderful dells would have been peopled in the popular imagination by countless troops of fairies and brownies. In the darker parts of the ravines masses of *Lomaria patersoni* hang their sombre deep-green fronds in the drip of the overhanging rocks. Higher up the streams, as one neared the limits of the bush (which ceases here at about 1500 feet), an occasional patch of *Gleichenia cunninghamii* or of *Lomaria vulcanica* might formerly have been met with, but these ferns—common enough in some other parts of the colony—seem now to be only memories to Dunedin collectors. On the upper limits of the bush, specimens of the native cedar, *Libocedrus bidwillii,* are met with.

On the open slopes of Swampy Hill itself, at the head of these streams, occur abundance of *Aristotelia fruticosa* and of the smaller-leaved tutus *(Coriaria thymifolia* and *C. angustissima)*, while *Olearia ilicifolia,* the native holly, is common on dry ground, and makes the eye glad and the air fragrant with its corymbs of white daisy-like flowers. Here, too, one comes out on the characteristic hill vegetation, clumps of *Phormium* and large tussock grasses *(Poa* and *Danthonia)* with an occasional spear grass *(Aciphylla)*, and a close ground growth of golden-flowered *Anthericum* or Asphodel, white and yellow composites, snowberries, and a few small orchids.

On the summit of the high ground one looks away down into Whare Flat, the bed of the Silverstream, gay in spring with the russet and golden blossoms of the Kowhai *(Sophora tetraptera)*, one of the few conspicuously flowered plants of the country, and beyond to the rugged western hills which bar the entrances to Central Otago. But to gain this summit which is crowned with peat and holds a lagoon in its highest part, such as is common on the summit of many of these southern hills, one must wade for a considerable distance over many acres of soft, deep sphagnum swamp, from which the name of the hill is derived. The facies of much of the vegetation is distinctly antarctic in type, and includes such plants as *Forstera sedifolia*, and *Oreostylidium subulatum*, *Gaultheria rupestris* the Alpine snow-berry, *Pentachondra pumila*, *Veronica buxifolia*, *Kelleria (Drapetes) dieffenbachii*, and of orchids *Caladenia lyallii*, *Chiloglottis traversii*, and *Lyperanthus antarcticus*. The moss itself is mainly composed of *Sphagnum (S. cymbifolium* and *S. cuspidatum)*, and it is rather curious that the decaying peat appears to exert such a decidedly acid reaction, that animal remains are completely dissolved by it. For among the moss may be found pockets of white quartz pebbles, masses as large as a man's head, sometimes mixed with partially decayed vegetable fibres; these are the gizzard stones of moas which in former times must have been very common in these parts. But no bones are to be found, they have probably been all dissolved out by the acid matter of the peat.

The frequent occurrence of north-easterly mist which hangs for many days at a time on the summit of the hill, together with the evenly distributed rainfall of the year, keeps the moss always bathed in moisture, and supplies the numerous rills and streams which flow in all directions from the slopes.

The cutting down of the bush and clearing of the surface vegetation which are inseparable from the spread of settlement, have caused the disappearance of many of the more delicate Cryptogams from the neighbourhood of Dunedin. Formerly the bush extended right down to the edge of the harbour and abounded with filmy ferns, tender mosses and hepaticæ such as love shade and moisture. But during the last three or four decades a great change has come over the vegetation of the immediate neighbourhood in this respect, and one has to go a good way afield to find unbroken bush in which the primitive conditions prevail.

It is rather remarkable, considering the facilities for distribution which they appear to possess, that so many of the common ferns of New Zealand should be altogether or nearly confined to these islands. Out of about sixty species found in the district round Dunedin, more than one-third are endemic. These include *Cyathea dealbata,* the Silver tree-fern, the most beautiful of the tree ferns and a very common one in the bush; and the still more abundant *Hemitelia smithii.* Another common tree-fern is the Black tree-fern—*Dicksonia squarrosa;* while on the slopes of Flagstaff Hill great numbers of *Alsophila colensoi* grow in the more open ground above the bush. This species seldom stands more than two or three feet above the ground, but its trunk is often prostrate for a length of six or eight feet. *Dicksonia antarctica,* a common Australian and Tasmanian tree-fern is also found in the local bush, but not so commonly as the three preceding species.

Filmy ferns used to be met with in abundance all round Otago Harbour in the old days, but they have died away as the bush was cleared. No less than fourteen species of *Hymenophyllum* and two of *Trichomanes* could formerly be gathered within an hour's walk of the town, but the collector has to go further afield now. Still most of them can be got in the bush gullies between Pine Hill and Mount Cargill, and in the creek beds at the upper waters of the Leith and the Waitati. They are mostly species of very wide distribution, but one of them—*H. malingii*—is quite peculiar and rare. This is a little greyish or tawny-coloured unpretentious species, covered with stellate hairs which give it its peculiar colour and appearance. It grows on Pine Hill and Mount Cargill under tree trunks and logs, and is probably much commoner than is thought, because it is very easily overlooked. The Kidney Fern *(Trichomanes reniforme)*, of which every visitor to New Zealand wishes to carry away a piece, grows very abundantly on the West Coast, about Stewart Island and the Bluff Hill, but is not found anywhere within fifty miles of Dunedin. *Adiantum affine*, the only maiden-hair fern of this district, occurs on both sides of the Harbour and in the coastal regions north and south. *Davallia novæ-zealandiæ* is an elegant and handsome fern found only in these islands. *Hypolepis millefolium*, another endemic species, occurs abundantly on the slopes of Flagstaff Hill, where its bright green much-divided foliage is very ornamental. It resembles some species of *Pteris* in its habit of dying down every winter, when its brown withered fronds give a warm russet tint to the hill sides. *Pellæa rotundifolia* and *Pteris scaberula* are also endemic forms, and are common on rocky ground. Of the large genus *Polypodium*, the handsome *P. pennigerum*, which grows especially well in woods and on the banks of streams, is peculiar to these islands, and is not uncommon in this neighbourhood. Two other endemic forms are frequently found here, *Todea hymenophylloides* and *T. superba*, known respectively as the Single and the Double Crape-fern. Both are beautiful delicate ferns, so thin and filmy in their texture that they will not stand cutting without quickly shrivelling. The former is very abundant, but the latter is also common in shady and damp parts of the bush. It is one of the conspicuous plants which mere fern raiders, who get up an enthusiasm for things which they only gather to destroy, are very fond of gathering. Consequently when its haunts are invaded by a picnic party, it is always more or less exterminated.

Many of the commoner ferns have proved to be quite hardy even under the changed conditions to which they have been subjected in the neighbourhood of settlement during the last few decades, and they can still be met with in abundance within the Town Belt of Dunedin. Thus the most familiar of our ferns, one of the most beautiful, too, and therefore largely used for household decoration, is the very variable *Asplenium bulbiferum*, so called from the abundance of little bulbils formed on the margins of its pinnules. This species, together with *Lomaria procera*, *L. lanceolata*, and *L. fluviatilis* carpet the ground in many parts. Mixed with these are the creeping rhizomes and broad green fronds of *Polypodium billardieri*. Formerly *Aspidium capense* used to be common on Otago Peninsula, but hardy as it is, it has succumbed to the drying up of the ground which has followed extensive bush clearing.

Magnificent specimens of *Aspidium aculeatum*, the large thickly scale-clad representative of the northern shield-fern, are still common, especially near water-courses.

Over a dozen species of club mosses occur in this colony, and of these the endemic *Lycopodium billardieri* is common as an epiphyte; it is a handsome, dark green pendulous species. *L. clavatum* is common on Flagstaff Hill and other high ground in the neighbourhood; while the elegant *L. volubile*, the largest and most graceful species of the genus, festoons the shrubs at the edge of the bush in all our uplands. Another common epiphytic species is *Tmesipteris forsteri*.

The lower groups of Cryptogams have not been worked out to any extent in New Zealand, though some attention has been paid by isolated collectors to the Mosses and the Marine Algae. But the beautiful order of Liverworts or Hepaticæ, which are so abundantly represented here, have hardly been collected, and the same remark applies to the Fungi. There is a great field open for the future investigators of all these forms of vegetable life.

The features in the flora which will most probably impress a botanist visiting New Zealand for the first time are the prevalent evergreen character of the bush land, the yellowish-white tough tussock grasses of the open uncultivated country, and the absence of brightly coloured flowers. A closer investigation will reveal the fact that the majority of the plants met with are of Australian genera, but mostly a good deal altered by long isolation. Prickly and spinous plants are very rare, but among the vegetation of the higher country are many tough-leaved or very hairy species, evidently protected against a formerly abundant insect fauna, which, however, of late years has been greatly reduced by introduced birds. Among the shrubs and trees, the proportion of forms producing succulent fruits is very large, the distribution of the seeds by birds being thus brought about, whereas those plants furnished with contrivances for catching passing animals is very small. This is only what we would expect in a country destitute of mammalia. The only New Zealand species so furnished are plants of wide distribution outside of these islands.

An unexplained feature of the flora is the great proportion of unisexual plants. Many of these are strictly diœcious, while many more are hermaphrodite in structure, but quite unisexual in function. This curious fact, in face of the common idea that the insect fauna is feebly represented, needs investigation. It seems probable that while Hymenoptera and some types of Lepidoptera are not abundant, flower-visiting Diptera and Coleoptera bear a large share in fertilising these imperfect native flowers.

Enough has been advanced to show that the native flora of New Zealand, though not characterised by features which appeal to the eye, yet furnishes problems of great interest to the botanist, and very many of these problems can be studied adequately without wandering out of sight of Dunedin.

ZOOLOGY.

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New Zealand Zoology.

The islands of New Zealand are, in respect of their fauna, in many ways so peculiar and interesting that, before giving an account of the local natural history, some remarks on the general character of our fauna deserve a place.

Our islands form, together, the largest land area that is absolutely without any native terrestrial mammal, for the only endemic representatives of this class are two bats, one of which occurs also in Australia, while the second is peculiar to these islands. The Maori rat appears to be identical with the Polynesian rat; and the Maori dog resembled the dog of Tahiti and South Sea Islands. There is little doubt but that both, being used as food, were introduced by the early Maori immigrants. *Mystacops tuberculatus*, the long-eared or short-tailed bat, presents certain anatomical features that are very exceptional among members of the order. For example, the flying membrane is differentiated into two regions: that part of it next the body is thicker than the outer region, and when the membrane is not in use the latter is folded up close against the body, and is thus protected from injury by being covered by the former. "With the wings thus encased this species is the most quadrupedal of all bats." The claw on the thumb, too, is remarkable in having a small denticle near its base, while the sole of the foot being rough, and to some degree adhesive, serve to increase its climbing powers. This bat is rare now, and we know little of its habits; but, according to some observers, it appears to live in large communities in caves and hollow trees.

The native Birds are extremely interesting, for many of them have lost to a less or greater degree, or even entirely, the power of flight.

Of flightless birds still living the most notable is the kiwi *(Apteryx)*, of which three or four species are still to be found in the wilder parts of the country, especially in mountainous regions covered with forest. Unfortunately this very flightlessness has led, in recent years, to the destruction of this and other birds, owing to the injudicious introduction of weasels and stoats for the original purpose of destroying the rabbits, but, like the rodents, these carnivorous vermin have increased in numbers, have over-run the country, and are rapidly exterminating the most interesting, characteristic and peculiar birds of New Zealand.

The kiwi is remarkable amongst birds for the minute and absolutely useless wings, which are hidden below the clothing feathers of the body. It also presents various unique anatomical features; it alone amongst birds has but one finger to the wing; the nostrils are on the lower surface, close to the tip of the very long, narrow beak; the organs of smell (and therefore the sense of smell, which in other birds is practically *nil*) are so greatly developed as to extend backwards between the eyes. On its face the feathers are hair like. The egg is nearly as large as the body of the parent bird, indicating a descent from an ancestor of much greater bulk. The kiwi is nocturnal in its habits, and it feeds on earth worms, the presence of which appears to be ascertained by its power of smell.

The extinct moas *(Dinornithidae)*, allies of the Australian emu and the African ostrich, which they exceeded in size, are even more remarkable in some respects. Some 15 to 20 species are known, belonging to several genera, which is quite an undue and unique proportion of giant flightless birds to so small a land surface as at present constitutes New Zealand. Some of them were small and clumsily built; others were taller and more graceful, attaining a height of 12 feet. The majority of them—indeed, all but one or two species—had absolutely no wings, and in many even the shoulder-blade had vanished. Although instances occur in all groups of vertebrates of the disappearance of the hind limbs, and even of both pairs of limbs, the moas alone had lost by degeneration of the fore limb.

Remains of various parts of the moas are exhibited in the Otago University Museum—not bones only, but feathers, eggs, windpipes, and even the dried skin and muscles around the leg and foot (which have been found in caves in Central Otago); while a reconstruction of the bird, clothed in feathers, is also on view.

The moas must have roamed over the land in great flocks; and many must have been overwhelmed by floods, or bogged in swamps, judging from the conditions under which their remains have been found.

According to Captain Hutton's calculations (Trans. N.Z. Inst., 24, p. 151, *et seq*) the moa was exterminated in the the North Island some 500 years ago, and in the South Island it perished about a century later. The extermination was, no doubt, chiefly brought about by the early Maoris, for we know that the flesh was appreciated by them, and probably the eggs as well, as eggshells and burnt bones have been obtained from Maori ovens. It appears probable that the young moas were preyed upon by a large raptorial bird *(Harpagornis)*, remains of which have often been found in association with those of moas. Other interesting extinct birds are the large goose *(Cnemiornis)* and great Rail *(Aptornis)* both of which were flightless.

Amongst the living carinate birds, reference may be made to our parrots; and foremost amongst them is the peculiar "owl-parrot"—the kakapo of the Maoris *(Stringops)*, the skull of which presents characters unknown in other parrots, while its sternum is practically keelless. Its face is rendered owl-like by a fringe of hair-like feathers round the base of the beak. The bird is green, flecked with yellow; is flightless, heavy in body, and stupid. It is nocturnal, lives in hollow trees or holes amongst the roots, feeds on grasses, mosses, etc., and makes a curious grunting noise when feeding. Dr Sclater terms it "one of the most wonderful, perhaps, of all living birds." It is, unfortunately, nearly exterminated.

The more sociable "kaka," or brown parrot *(Nestor meridionalis)*, is arboreal, feeding on insects and honey. The mountain parrot or "kea" *(Nestor notabilis)*, inhabitating the mountain tops, is still common in the Mount Cook district, where its mournful cry and inquisitive and playful habits may be experienced at the Ball Hut, as well as elsewhere in the South Island. It is famous the world over for having taken to eating mutton. No doubt, at first, driven to this in times of scarcity of its normal food; the habit, like evil habits generally, has grown till it has in some parts become a pest. These birds frequently attack a living sheep, drive it away from the mob, and cause its death by pecking its flesh away, till they reach the kidney fat, which prized dainty being consumed they abandon their victim.

The group of rails is represented by species of the Maori Hen or "weka" *(Ocydromus)*—a fat, dark brown bird, whose wings, though large, are useless for flight, owing to the imperfections of the wing quills. Anatomically it is remarkable for the large "coraco-scapular angle." The bird is of a social and inquisitive disposition. It still lives in high forests, though it is much reduced in numbers by the introduced carnivores. But the most interesting rail is the "takahe" *(Notornis)*, allied to the swamp-hen *(Porphyrio)*. It is a very handsome, dark blue bird, with bronzy-green wings (which are useless for flight), and with bright red legs and beak. It is one of those birds that are met with at such long intervals of time as to be signalised in some books as "extinct." Of this bird, though parts of the skeleton have been found in fissures and caves and elsewhere in Otago, yet the skins of only four birds have reached naturalists. Two are in the British Museum, one in the Dresden Museum, and the fourth (captured in 1898) was fortunately retained in the colony owing to the liberality of the New Zealand Government in purchasing it and depositing it in the Otago University Museum.

The crooked-billed plover *(Anarhynchus)* is another bird peculiar to these islands, and is unique in that the bill is curved horizontally towards the right side, so that it can readily seek its food below stones.

The Blue Mountain duck *(Hymenolaemus)* may still be met with in mountains, lakes, and rivers. Its whistling note and fearless character render it sufficiently interesting to be protected even by settlers and others. Its bill has a curious loose flap of soft membrane on each side.

Of smaller birds, the honey-suckers are of interest for their beauty, as well as for their peculiarities. The bell-bird *(Anthornis)*, the tui *(Prosthemadera)*, and the almost extinct stitch-bird *(Pogonornis)* are found nowhere outside New Zealand. Our native starlings, too, are similarly noteworthy, especially as the family is unrepresented in Australia. These are the rare saddle-back *(Creadion)*, the wattled crow *(Glaucopis)*, and the "huia" *(Heteralocha)*, the last named being confined to the North Island, and famed as providing the white-tipped black feathers so prized by Maori chiefs. The marked difference in the form of the bill in the two sexes of this bird is peculiar.

Some of our birds illustrate the principle of evolution by "physical isolation," in that a distinct species occurs in each island. For example, the tits *(Myiomoira)*, the robins *(Miro)*, the thrushes *(Turnagra)*, the wattled crows *(Glaucopis)*. But in addition to the many peculiar genera of land birds, "No other country in the world possesses so many shags or cormorants *(Phalacrocorax)* of which New Zealand possesses some nine or ten species, of which at least half are peculiar."

Leaving the birds, we may pass to the REPTILES, the most remarkable of which is the "tuatara" *(Sphenodon)*, now nearly extinct, except on a few rocky islets in the Bay of Plenty and in Cook Strait, but formerly widely spread over both islands. It is the sole living representative of an order of reptiles which, never numerous, flourished in early Mesozoic times; and we have to go back to the Jurassic period to meet with its nearest relatives in the form of fossils. This order *(Rhynchocephalia)* contains the most archaic representatives of the Reptiles, and is the earliest order to make its appearance in the history of the world, appearing as it does in Permian times. The order has thus the longest history of any of the reptiles, and the tuatara is the "oldest" reptile living on the earth. It dwells in company with certain species of petrel in burrows in the soil, but it lays its eggs in special holes away from its dwelling. In olden times it appears to have been used as an article of diet by the Maoris. Individual tuataras are known to live to a considerable age, but whether the "term of its natural life" is as long as that of the giant tortoise of the Galapagos, we have no records by which to decide.

Of the class **AMPHIBIA**, New Zealand can boast of only a single representative—viz., a small frog *(Liopelma)* limited to the province of Auckland, in the North Island, and extremely rare, if not extinct. Curiously enough, this frog belongs to a family absolutely distinct from those to which the Australian frogs belong. The family *(Discoglossidae)* has representative species in Southern Europe and North Africa, another in China, and another in North America.

Our fresh-water **FISHES** are of interest from the small number of genera (six) occurring here, and from the large number of species (about a dozen) of the genus *Galaxias*, which attains its greatest development in these islands and in South America.

One of our species, *Galaxias attenuatus*, the "minnow" of the settlers, occurs also in the waters of Tasmania, Falkland Islands, and Patagonia. This is the only species which descends the rivers for the purpose of spawning in the sea; this it does in February and March, returning in April and May., while the young ones commence to ascend the rivers in August in vast number, and constitute the "whitebait" of commerce. A peculiar degenerate galaxiad is only found buried in mud or clay at some distance from streams: this is the "mud fish" *(Neochanna apoda).*

Of Salmonoids we have but one fresh-water species, the "smelt," belonging to a genus *(Retropinna)*, which is confined to New Zealand.

The "grayling" *(Prototroctes)* represents the family Haplochitonidæ, the distribution of which is of special interest in relation to the theory of an Antarctic continent. A fifth species is a goby *(Eleotris)*, which is widely distributed in the tropics of both the New and the Old World; and a trachinid *(Cheimarrichthys)* is almost the only member of its family that lives in fresh water.

Our lamprey belongs to the same genus *(Geotria)* as occurs in Australian and Chilian rivers. Dr Dendy has shown that the pouched form, hitherto regarded as a distinct species, is really the adult of *G. australis.*

One noticeable and agreeable feature about our fauna is the almost total absence of noxious terrestrial animals, the only representative being the spider termed "katipo" *(Latrodectes)*, which is closely allied to the Queensland species, and, like it, is a good instance of "warning colouration," its colour being black with a bright red mark on its back. It has not yet come as far south as Dunedin. Visitors, therefore, from the "other side" of the Tasman Sea may feel assured that as snakes are absent from our bush there is no need for wariness in camping or picnicking; nor are there "bull-dog ants" to protest against a sudden intrusion into their domain.

Nevertheless, the sandfly and the mosquito make their presence known in various parts of the country; but as the malaria mosquito *(Anopheles)* is non-existent here, the only sequel to an attack is a temporary irritation of skin and temper.

The relations of our fauna to that of other parts of the world is very complicated, and it is impossible and unnecessary to enter into details here, but by the courtesy of Captain Hutton, and by permission kindly granted by the Council of the Philosophical Institute of Canterbury, I am able to make the following quotations and abstracts from the valuable introduction to the "Index Faunæ Novœ-Zealandiœ," which is being published by that institute under the editorship of Captain Hutton:—

"The stationary portion of the fauna may be divided into (1) a small aboriginal element, including species which have no near relatives elsewhere; and (2) larger Malayan, Australian, and Antarctic elements, as well as several smaller ones. . . . Taking a broad view of the whole fauna, it may be said that the terrestrial portion is chiefly of Malayan origin, but with rather strong Palœarctic and Neotropical connections. The fresh-water fishes and crustacea are chiefly Australian and South American. . . . The marine fauna is chiefly Australian and Antarctic. . . ."

"The aboriginal element includes the short-tailed bat *(Mystacops)*, the tuatara *(Sphenodon)*, and the kiwi *(Apteryx)*, to which may be added the following birds: *Glaucopis*, *Heteralocha*, *Turnagra*, *Xenicus*, *Stringops*, and *Nestor*; the land mollusc *Carthaea*, and many insects."

"The Malayan and Melanesian element embraces nearly the whole of our land fauna, and a considerable portion of the marine fauna as well. It includes all the land birds (but the above-mentioned and *Zosterops)*; all the lizards; some fishes; nearly the whole of the land mollusca, and many marine ones; a very large number of insects, including the whole of the Phasmidae and Stenopelmatidae."

"The Ethiopian element is small, but remarkable. Most noticeable is the relation between the extinct Dinornithidae and the *Æpyornithidæ* of Madagascar. Our fern bird belongs to a genus *(Sphenaeacus)*, which is only found in New Zealand and South Africa, but it has its nearest ally in Madagascar."

"The Oriental element includes our tree-lizards *(Haplodactylus)* found only in New Zealand, Queensland, and India; our frog *(Liopelma)* has its nearest relation in China; the black butterfly *(Percnodaimon)* is said to have its nearest relative in the Himalays."

"The Australian element is entirely made up of forms belonging to the Malayan element in the Australian fauna, which overran Australia and Polynesia at a comparatively late date." For example, "the long-tailed bat *(Chalinobolus morio)*; and among birds *Zosterops*, *Haematopus*, and *Spatula*; several marine fish, such as *Arripis* and *Latris;* the land shell *Laoma;* some marine mollusca; some crabs, such as *Paramithrax* and *Nectocarcinus*; the fresh-water isopod *(Phreatoicus*; . . . perhaps the land planarians; and the earth-worm *(Diporochaeta)*."

"The Antarctic element contains chiefly marine forms, such as seals, penguins, cormorants, and the black-headed gull, as well, perhaps, as the black oyster-catcher. The fresh-water fishes, *Cheimarrichthys*, *Prototroctes*, *Galaxias*, and *Geotria*; certain marine fishes, such as *Notothenia*, *Bovichthys*, *Genypterus*, *Gonorhynchus*, and *Callorhynchus*. There are also several Antarctic crustacea, such as *Cyclograpsus*, *Halicarcinus*, and *Sphaeroma gigas*. Of marine mollusca there are *Ranella argus*, *Struthiolaria*, *Plaxiphora*, *Callichiton*, *Venus stutchburyi*, *Solenella australis*, *Mytilus magellanicus*, and others. Our Brachiopods are more closely related to those of the Straits of Magellan than they are to the Brachiopods of Tasmania."

The Acanthodrilid earth-worms of the genus *Notiodrilus* are found only in New Zealand, the Auckland and Macquarie Islands, Kerguelen, and Marion Isles; South Georgia, Falkland Isles, and Patagonia; the Cape of Good Hope and Madagascar.

The aquatic worm *Phreodrilus* occurs in New Zealand, Kerguelen, Falkland Isles, and Patagonia.

"The Neotropical element.—The merganser of the Auckland Islands has its nearest relative in Brazil; our blue duck *(Hymenolaemus)* forms with *Salvadorina* of Waigou, and *Merganetta* of the Andes, a distinct sub-family. The Neotropical element is tolerably abundant among our insects. Our fresh-water crayfish *(Paranephrops)* is also closely related to those of S. America and Australia." The same is true of *Temnocephala* and the earth-worm *Microscolex*.

Captain Hutton points out that it is a mistake to regard our fauna as altogether an "insular fauna," as we have a number of animals which it is impossible to believe crossed over the sea. The relation of the fauna with Tasmania and Australia is weak in comparison with the Malayan element. The low type of a great part of the fauna, which, however, shows a great variety of form, indicates that it is essentially an old one; and many of the higher types are absent. "To explain the connection between New Zealand and some ancient land it is necessary to assume the existence of a former continent, either in the Antarctic region or in the Pacific, of which Patagonia, Australia, New Guinea, and New Zealand formed parts. But in either case the land communications must have been broken up a very long time ago."

The best zoological evidence for a former Antarctic continent is furnished by the earth-worms of the genus *Notiodrilus*. While the floras of the Antarctic Islands are also considered as evidence in this direction.

LOCAL FAUNA.

The following account is not to be regarded as even an approximately complete list of the animals occurring in the neighbourhood of Dunedin; it is merely a brief sketch of such forms as may be most probably met with by any naturalist accustomed to collecting. For convenience, the fauna is arranged according to its physical distribution—i.e., terrestrial, fluviatile, and marine-littoral.

Dunedin is conveniently situated for the study or examination of each of these faunas. The town is surrounded by a Town Belt, which is part of a natural bush, and though a good deal overgrown by introduced plants and cut up by roads and paths, yet it still retains in places remnants of the native forest in the form of trees, upstanding or down-fallen, in the crevices of which a few members of the native fauna are still to be met with. But close at hand, some three or four miles away, are Flagstaff Hill and Mount Cargill, each rather more than 2000 feet above sea-level, and both are covered to some, but a continually decreasing, extent by unspoiled native forest, where representatives of our fauna may be found; while still further away is Swampy Hill, which affords opportunities of a similar kind.

The Water of Leith, its tributaries, and a few other streams rising in the hills around, afford some opportunity—though truly not a good one—of gathering representatives of the fluviatile members of the fauna.

But there is a much better scope for studying the marine fauna:—Firstly, in the harbour, which in the lower portion, at and below Port Chalmers, is still unsullied; and, secondly, the beaches to the north of the Heads and to the west of the town—such as Moeraki and Brighton respectively—which afford really excellent collecting grounds. The former, however, can only be reached by train; the latter by road. But even on the Ocean Beach at St. Clair there are occasionally thrown up some interesting animals.

The harbour side and the wall bounding the ship channel afford ready opportunities of collecting many groups of animals.

LOCAL TERRESTRIAL FAUNA.

Underneath logs and blocks of stone, or in the crevices of rotten fallen trees in the Town Belt, and even in the gardens in the outskirts of the town, several species of land PLANARIANS *(Geoplana)* are to be found. The long, flat, slimy body, pointed at either end, is in most species dark in colour—of some tone of brown, grey, or purplish hue—with two or more bands or streaks of lighter colour, frequently yellowish, running lengthwise. These animals are mostly of small size, one and a-half to three inches in length, though one species attains a length of eight inches. Although a land Nemertine *(Geonemertes)* has been found in New Zealand, it has not hitherto been met with in this district.

Of the EARTH-WORMS several native species may still be met with in the neighbourhood, though, of course, as elsewhere, those found in gardens are introduced British species.

In rotten logs a short, cylindrical worm, about 1½in in length, of relatively stout build, and of a dark chocolate colour marked with white spots, may frequently be discovered; this is *Plagiochaeta sylvestris*, a member of an endemic genus. It is a remarkably active fellow; readily climbing vertically upwards by means of its numerous bristles. It so closely resembles the rotten log in which it lives that it is not easy to detect it, especially as the white spots break up the brown colour and cause it to resemble the crumbling wood. On being seized it sometimes breaks into two, so that it is "protected" both by its colour and its self-rupture against the attacks of birds.

Another worm, greenish-grey in colour, of greater length and of slenderer form, may also be found in or under logs. This, too, is an endemic worm *(Neodrilus)*. Larger species, dark green or purple in colour, attaining a length of 8 to 10 inches, belonging to the genus *Maoridrilus* (another genus peculiar to New Zealand), are also occasionally met with under larger stones and logs, but are commoner in the high country, away from cultivation; while in ploughing the fields pale pinkish or whitish worms (belonging to a fourth peculiar genus *(Octoehaetus)*, are commonly turned up.

It is rather a curious fact that no land leeches have hitherto been found in New Zealand.

To biologists the little caterpillar-like creature *(Peripatus)* is of perennial interest, both on account of its geographical distribution and, still more, on account of its structure, for, in certain respects, it forms a link between the Annelids or ringed worms and the hard-shelled Arthropods. Our New Zealand species is a handsome velvety greenish brown creature, about 1½in to 2in in length. I have found it occasionally in rotten logs in the Town Belt.

The CRUSTACEA are represented by four or five species in the bush, the most noticeable member of the class being a small shrimp-like animal, which one may see by turning over dead leaves or rotten wood or stones, when it brings itself to notice by its power of jumping. This "Hopper" *(Orchestia sylvicola)*, closely allied to the "shore-hopper," is to be found miles away from the sea, even on mountains of some height.

In addition to certain introduced "slaters" or "wood-lice," some native species occur more or less commonly, especially *Oniscus punctatus*. Another one *(Armadillo rugulosus)* is endowed with the power of rolling itself up in a ball like the "pill-worm" of the Old Country; while the genus *Trichoniscus* is represented by three species, one of which is common in the decaying leaves of the native flax *(Phormium)*.

The MYRIAPODA are pretty well represented round Dunedin, about a dozen species having been recorded by Captain Hutton. The Millipedes are more numerous than the Centipedes. Of the former a dark brown *Julus antipodarum*, and a pale rose red *Polydesmus*, a shining black *Sphaero-*

therium, and a brown, hairy *Craspedosoma* are all fairly common in suitable places. The Centipedes *(Henicops, Himantarium)* have the usual orange-brown colour and active habits of the group, though our species are of small size and appear to be harmless.

Of the SPIDERS (Arachnida) it is impossible to mention a tithe of our local species, of which a considerable number have been described. There occur in the neighbourhood, besides Epeirids and other "snare builders," several "trap-door" spiders *(Cambridgea, Nemesia, Migas*, etc.), some of which are of considerable size, but as far as my experience goes, are quite unobjectionable in their manners. The burrows of some of these are provided with the usual neat trap-door, covered with bits of the surroundings so as to be extremely difficult to discover; others, like *Lycosa bellicosa*, are without the door.

A specially cunning little beast is *Arbanitis huttonii*, whose main burrow has a wide open mouth, but has a side branch, narrower and trapped at the top. The spider lives in this side chamber, lying in wait for its prey, which enters by the wide opening; the spider darts out upon it from the rear after it has passed the entrance of the narrow side tube; or possibly retreats through the back door if the intruder is larger and more powerful than itself.

Amongst the many kinds of spider infesting the "manuka" or "ti-tree" *(Leptospermum)* is one that spins a very cunning "nursery," which is conspicuous near the top of the shrub. The white silken wall—spindle shaped or conical in form—embraces several small shoots; and the eggs are laid in a silken cocoon attached thereto, within the nursery. As the young hatch out they bite through the cocoon wall and find themselves enclosed in the larger hall; in due time, as the babies get strong enough, they eat their way through the wall of the latter, and thereupon step out into the world.

A handsome black "harvest-man" (or Phalangid) is frequently to be seen on our roads and pathways in late summer. The very long "chelae," held up, folded in front, and the very long and excessively delicate legs supporting his wee black body give it altogether a quaint appearance. It has only recently received baptism, and is now termed *Pantopsalis nigripalpis.*

The class of INSECTS (Hexapoda) is but sparsely represented in New Zealand; nevertheless we have a fair proportion of peculiar forms, some of which are curious from whatever point of view they are considered—structural, distributional, or fanciful; yet it is possible to refer to only a very limited number in this article.

In most countries the LEPIDOPTERA—i.e., butterflies and moths, are the most handsome and conspicuous of the insects; but New Zealand possesses remarkably few butterflies, only 15 species belonging to three families having been met with.

In our neighbourhood the following may probably be seen: A "Red Admiral" *(Vanessa gonerilla)* is common from January to April; it is black with a large dark red band on each wing, with smaller white and some blue spots.

The cosmopolitan "Painted Lady" occurs very rarely; a "Meadow Brown" *(Argyrophenga antipodum)* is to be met with in tussock land on mountain sides. A "Copper" *(Chrysophanus salustius)* occurs in open situations; while a "Purple Copper" *(C. boldenarum)* is common in stony places, especially near river beds. Finally, a small "blue" *(Lycœna oxleyi)*, which may occasionally be seen, completes the list of commoner locals.

As to MOTHS, we have space only to refer to two out of a fairly long list. One is an extremely common day flyer *(Nyctemera annulata)*. Its black wings have cream-coloured markings; its body is black, with orange lines. It is, indeed, an excellent example of "warning colouration"; and its lazy flight and careless habit of settling with wings expanded emphasise the fact.

The second moth is of interest on account of the rarity with which the imago is seen, for the larva is very common. *Œceticus omnivorus* is a Psychid; the female is wingless; the larva spins a tubular house for itself, interweaving pieces of its food plant on the outside. For some weeks of its life the larva carries its house about with it during its excursions to get food, but later on hangs it to a branch of its favourite plant (chiefly *Leptospermum* in our neighbourhood, where the cases may be seen on nearly every shrub in some parts of the hills). At night the insect leaves its house for food, but keeps up a silken connection so that at the slightest alarm it may be able to retire to safety, closing the soft doors behind it. Here it remains snug throughout the day. Later on in life it pupates in this same house.

Of other insects, a very interesting little Collembolid *(Anoura spinosa)* may be, very occasionally, found in rotten logs. It is a soft-bodied, wingless insect, somewhat oval in outline, about ¼in in length. Its colour is bluish grey, but numerous yellow spines give is a bright tone. A small cockroach occurs commonly in the bush. The "STICK INSECTS" (Phasmidae) of New Zealand are all wingless; they belong to four genera, of which two are confined to these islands. Some two or three species (of *Argosarchus*, *Pachymorpha*) are common on the Town Belt, and not unfrequently appear on the verandahs of the houses abutting thereon. Some are green, but more usually they are brownish-grey, like a piece of dried twig; and in their natural habitat they assume such unsymmetrical and awkward positions as to resemble a branched twig most closely; and are consequently very difficult to find.

The grasshoppers are not now common around the town; but in some parts of the country they are still fairly abundant in spite of the destruction wrought by the introduced birds. They occur in fair numbers in the neighbourhood of the Mount Cook Hermitage, where several species may be collected. Altogether about 20 species have been recorded from the colony, belonging to eight genera, of which four are endemic.

But, perhaps, of all our insects, the "WETAS" are the most curious; the name is given to a group of locust-like Orthoptera without wings, belonging to the family Stenopelmatidae, which is better represented in New Zealand than in any other part of the world. We have 30 species, belonging to 13 genera, and most of them are peculiar, such as *Deinacrida*, *Hemideina*. In our neighbourhood *Onosandrus pallitarsis* is the commonest; it is met with among roots of plants, etc.; the larval stage is passed in the ground; and it is frequently dug up in our gardens.

During the hot days of summer the air is frequently filled with the shrill cries of the male Cicada or "Singing locust," as it is misnamed. All our Cicadas, of which only eight species have been recognised, belong to a single genus *(Melampsalta)*, and that a widely ranging one. They thus form a very marked contrast to the numerous endemic genera of Australia. Two, perhaps three, species are commonly found in this locality—distinguishable by their colour and by their sound. The introduced birds have caused a very great reduction in the number of these and some other insects.

Of the DRAGON-FLIES at least three are fairly common here; of these the most abundant is *Lestes colensonis*, of which the male is bronzy blue, the female dull bronze. The male of *Xanthagrion zealandicum* has a bright red body, while the female is bronzy black. Our largest common species is *Somatochlora smithii*, which attains a length of two inches; the thorax is metallic, bronzy green; the abdomen dull red. In the country, a still larger species about four inches in length is to be seen *(Uropetala carovei)*.

Of our HYMENOPTERA, the most conspicuous is a large and brilliantly-coloured ichneumon fly *(Rhyssa fractinervis)*, the female of which has very long ovipositors; but our commonest is *Probolus sollicitorius*, dark in colour, with a broad orange band encircling the abdomen.

There are no Social Hymenoptera in New Zealand, with the exception of a few ants, and these contrast with those of Australia in their small size, fewness of species, and comparative rarity. Our commonest ant is about one-eighth of an inch in length, of a dark brown colour *(Lasius zealandicus)*; while a second ant *(Ponera castanea)* is larger and brighter.

The European hive and bumble-bees have been introduced, and have spread all over the country; but of native bees and wasps we have but few.

Dasycolletes hirtipes, the mason-bee is a dull grey insect, three-quarters of an inch in length, and constructs its clay nest in crevices in the bark of trees, etc.

Pomphilus monachus is also abundant; and has the usual habit of the tribe of collecting and paralysing spiders as food for its larvæ.

Of our **Flies** it is impossible to give any account in the space available; but the native "glow-worm" may be mentioned; both the imago and the larva of *Bolitophila luminosa* are phosphorescent; the latter lives usually in caves.

A very large number of **Beetles** have been described, of which one or two may here be mentioned. Our largest is a "Cockchafer" *(Prionoplus reticularis)*, which is, in some seasons, very abundant in the outskirts of Dunedin. Its larva may be found in rotting logs—a large, white, fleshy grub, much appreciated by the Maoris as an article of diet. It is said to possess a fine nutty flavour.

A handsome little Cicindela *(C. tuberculata)*, green with cream-coloured markings, is common, especially in dry places; the burrows of the larva are very conspicuous in dry banks; each larva lies in wait for small insects, with its horny head close to the mouth of its burrow.

Another bright little beetle *(Pyronota festiva)* is also common—a small lamellicorn with light metallic green wing-covers. A small brown species with thin elytra is a *Rhizotrogus zealandicus*. Less conspicuous are the species of *Trichosternus*, which are nearly black, but with a bronzy green iridescence; and *Mecodesma*, a dull black, with flatter and broader body.

One of the Melolonthidœ *(Odontria striata)*, which is a stout, grey-brown form, with hairy wing cover, is abundant; its larvæ do considerable damage to grass by devouring its roots. A weevil *(Rhynchodes ursus)* also may be frequently met with; a stout, long-snouted, furry-looking beetle, with thick elytra of brown colour.

Our local terrestrial SHELLS are few and very inconspicuous owing to their small size. About a dozen species belonging to the genera *Endodonta*, *Flammulina*, *Laoma* and *Phryxgnathus* occur; but in addition to these snails, there are two or three species of bitentaculatre slugs *(Athoracophorus* or *Janella)* which may be met with in the Town Belt in suitable situations.

This, of course, does not exhaust our native terrestrial mollusca, for in the northern part of the South Island and in the North Island, large and handsome shells belonging to species of *Paryphanta* occur; while in certain parts of the North Island, the important genus *Placostylus* is represented by a large species *(P. hongii)*.

Turning now to the VERTEBRATA, two lizards commonly occur in the country immediately surrounding the town. One is a smooth brown scincoid *(Lygosoma moco)* with black linear markings along the sides, which is common amongst the low-growing fern *(Lomaria procera)* which covers the sides of dry and stony hills, such as that above the rifle butts.

The second is a gecko—a tree lizard belonging to an endemic genus *(Naultinus)*; it has a green velvety skin, usually with diamond markings of brown along the back; but it is very variable in colour and pattern; this is sometimes met with on the Peninsula.

A few of our native **Birds** may still be met with in the neighbourhood. The commonest is the cheerful little warbler *(Gerygone flaviventris)*, which may be heard in the gardens at the northern part of the town, or in the Town Belt; but it is not so easy to catch sight of the bird itself, owing to its "protective colouration." It is in the hanging nest of this species that the cuckoo deposits its egg.

The black and the pied fantailed fly-catchers *(Rhipidura)* may be seen flitting over the streams, or from tree to tree in the more retired parts of the Belt; they are very friendly, fearless little chaps, and flirt with one in a delightful way as one walks along the tracks.

The pale olive-green bell-bird, which belongs to a genus peculiar to New Zealand *(Anthornis)*, is still in our neighbourhood; its four, clear, bell-like notes at descending intervals may be heard in the Belt, and in the bush round the reservoir, where on a quiet day, one may keep a bird in conversation for several minutes, by imitating these notes, for it is fairly fearless of man. At other times of the year its note is single, repeated at intervals like the tolling of a bell.

The "tui" belongs to another endemic genus *(Prosthemadera)*; it is less common; yet when certain of our native flowers are in bloom—such as fuschia, "kowhai" *(Sophora)*, flax *(Phormium)*, or the introduced blue-gum tree *(Eucalyptus)*—a few specimens will congregate on the tree tops, and there contend with the bell-bird for the honey.

The tui is a handsome bird, of a dark metallic greenish-blue colour, with a little tuft of white feathers on its throat recalling the "bands" of evangelical clergy of former days; hence the name

"Parson bird" given to it by settlers. It is an excellent mimic, imitating as well "the crow of a cock as the barking of a dog"; but it ends its song, whatever it may be, with a sort of sneeze, or cough, or laugh.

The following smaller birds may also, occasionally be seen in the Town Belt, and more certainly on Flagstaff Hill and elsewhere away from town:—The pale-breasted tit *(Myiomoira)*, the bush wren *(Xenicus)*, and the creeper *(Certhiparus)*. All the genera hitherto mentioned are amongst those peculiar to New Zealand; but a common little bird, the white-eye *(Zosterops)*, has introduced itself from across the Tasman Sea within the last half-century.

The brightly-coloured kingfisher *(Halcyon)* may be seen, not unfrequently, up the Leith Valley; while a hawk *(Harpa)* and a harrier *(Circus)* may be looked for in the open country.

FLUVIATILE FAUNA.

The opportunities for studying the fresh-water fauna are unfortunately rather limited. The River Leith and other smaller streams are too rapid; the Kaikorai is too befouled; while there are but few pools other than artificial ones, which are apt to be peopled by introduced organisms. And, as a matter of fact, no systematic exploration of our fresh-water fauna has been undertaken. Nevertheless, the following may be looked for:—

The fresh-water Planarians have not been studied; but specimens very similar to the European *Planaria* have been collected in the Leith. Of OLIGOCHÆTA, the only peculiar genus that I have met with is *Phreodrilus*, whose geographical distribution has already been referred to; but the widely-spread genera—*Limnodrilus*, *Lumbriculus*, and *Nais* have been collected.

No leeches have as yet been found in this neighbourhood, but it is worthy of record that two genera, at least, have reached the hands of naturalists. Dr Dendy has described a *Glossiphonia* (perhaps *Microbdella)* from Lake Takapuna in the North Island; while a species of *Hirudo* has recently been found on an island off the West Coast of the South Island; and leeches have been stated to occur in various fresh-water lakes and lagoons.

The horse-hair worm *(Gordius)* is represented by a white and a dark brown species.

The list of common fluviatile MOLLUSCA is a compartively small one: *Unio (Diplodonta)* and *Sphaerium* are to be found in suitable streams; *Pisidium* occurs on aquatic plants; and amongst Gastropods, *Potamopyrgus* is represented by small species, e.g., *P. antipodum*, a viviparous form, with smooth shell, dark olive-green in colour, and about one-third of an inch in height; while *P. corolla* is even smaller, and its reddish-brown shell has rows of short spines on the whorls.

Of Lymnaeids, we have *Amphipeplea, Isidora,* and a minute *Planorbis.*

Although no endemic Polyzoa have been yet discovered, the European genera *Plumatella* and *Paludicella* occur in the Leith.

Of the CRUSTACEA, the following are more or less frequent:—I have collected the freshwater crayfish *(Paranephrops)* in Ross's Creek which feeds the reservoir; and on its shell a species of that peculiar ectoparasitic creature, *Temnocephala*, may be found.

A shrimp *Xiphicaris curvirostris* is common in running streams; and an Isopod, *Idotea lacustris*, originally discovered in the Tomahawk lagoon, has now been collected in the streams that run down the sides of Mihiwaka, Swampy, and other hills. The Amphipods are represented by *Hyalella mihiwaka*, and *Calliopsius fluviatilis*, both of which are common in some of our streams.

Of Insects, the usual caddis-worms and ephemerid-nymphs, with tracheal gills, are represented by species of *Atalophlebeia* and *Deleatidium* in the Leith; as well as by the large brown larva of *Chauliodes diversus* (one of the Sialids), in which each abdominal segment is provided with a pair of stiff, filamentous gills.

In still pools, a water-beetle *(Colymbetes rufimanus)* and a water boatman may be seen swimming on the surface and diving to the bottom in the usual fashion.

An aquatic Spider *(Dolomedes)* also lives in the Leith.

The native Fishes are rare, hereabouts, but *Galaxias fasciatus* occurs in the streams out of town.

MARINE LITTORAL FAUNA.

In dealing with this part of our local fauna, we may include, not only Otago Harbour (which has yielded a considerable number of species in these groups—especially the Crustacea—which have been carefully worked at) but also the beaches in the immediate neighbourhood: such as Brighton to the west, and Moeraki, north of Dunedin; both of these have been worked by naturalists. Further, the Long Beach, and Murdering Beach, just north of Otago Heads, though they have not been systematically worked, afford good opportunities for collecting. It is advisable to limit our list to truly littoral fauna, for to consider the inhabitants of the deeper water would take too much space, and indeed our knowledge is very fragmentary; though several interesting forms have, since the establishment of trawling for fish, been accumulating and await study.

It will be noted below how few groups have received adequate study; many of the lower invertebrates in fact are scarcely known. Naturally, in a land where the terrestrial fauna is of so much interest and is so rapidly disappearing, it has been of greater importance to study it, than the marine groups; especially as the number of naturalists doing serious systematic work is and always has been very limited.

Of the CŒLENTERATES, the Hydroids alone have been carefully worked over; and a number of cosmopolitan genera have been recorded, but no strikingly peculiar forms have been met with, if we except the very interesting pelagic *Pelagohydra* recently described by Dr Dendy.

The larger jelly-fish seem to visit our coasts only rarely; occasionally the Ocean Beach at St. Clair is covered with a large species, a foot or more in diameter; but, so far as I am aware, it has not been identified

A Lucernarian has been recorded from Brighton. *Physalia* and *Physophora* are also occasionally cast up; and one or two Ctenophorans.

Of the Anemones, a small form common in Logan's Lake at Pelichet Bay, is half buried in mud and sand; and a few larger ones occur on the channel-wall down the harbour; others, of course, in rock pools. Some seven or eight species have been described, some twenty years ago, and referred to the genera *Oulactis*, *Phymactis*, *Anthea*, and *Gregoria*.

A number of horny sponges (Chalinids) occur as well as the calcareous *(Grantessa)* and siliceous sponges.

As to PLANARIANS, two or three species may be collected under the stones along the harbour side; but have not been examined by modern methods

The NEMERTINES are commonly represented by a large, pale carmine-coloured *Amphiporus*; and other species—white, and brownish—occur; these are being worked at.

Of ANNELIDS, of which I am preparing a memoir, the following may be collected:—The commonest and handsomest is *Eulalia microphylla*, which occurs under nearly every largish stone along the harbour side, at certain seasons. It is a rich dark green, with yellowish-green parapodia. In the same situation, but burrowing in the mud, are a greenish *Nereis*, an orange *Cirratulus*, and other forms.

A very fine Polynoid *(Lepidonotus giganteus)*, which sometimes attains a length of four inches, not unfrequently occurs in the lower harbour; while smaller species *(L. polychroma*, *Harmothoe*, spp.) may be found at Port Chalmers.

Attached to the rocks in the clearer water of rock pools, are two very handsome Serpulids, with calcareous tubes:—*Vermilia hystrix*, with fine red gills; and *Placostegus carinatus*, in which the gill-crown is very dark blue.

On the sand of the beaches outside the Heads the beautiful conical sand-tube of *Pectinaria* is sometimes present in quantities; while the characteristic tufts of sandy-threads indicating the mouths of the tubes of *Lanice* may also be found.

Buried in the mud of some of the bays along the harbour side is a species of *Arenicola (A. assimilis)*, identical with that occuring at the extreme south of the American continent, off South Georgia, the Falkland Isles, and the Macquarie Islands.

On the more open beaches we may find *Marphysa depressa* below stones, or in clefts of rocks, enclosed in a membranous tube; and also a species of *Branchiomma*, and various Terebellids.

The CRUSTACEA is one of the best known of our invertebrate groups, thanks to the work of Mr G. M. Thomson and Professor Chilton. The class contains a considerable number of endemic species.

Amongst the shore crabs, two species of *Heterograpsus* are common below the stones along the harbour side; handsome little fellows, mottled red-brown and whitish; and *Hymenicus varius*, a tiny thing with a soft, greyish, flat back. Along the mud and clay shores *Helice crassa* and *Macrophthalmus hirtipes* are to be seen scurrying along, at your approach, each seeking its burrow. In the cleaner water at Port Chalmers the curious "Half-crab" *(Petrolisthes elongatus)* is extremely common under stones; it is pale bluish in colour, with long, powerful nippers of a reddish tint. Another member of this group is the bright red "Whale feed"—as a matter of accuracy it is fish feed and bird feed as well—known as *Grimothea*, which is believed to be the young of *Munida subrugosa*—one of our many species which have a wide distribution round the Antarctic regions. The "whale feed" come up the harbour in shoals of thousands, so that large areas of the water are blood-red in colour; they are thrown up on the shore in such quantities as to become an objectionable nuisance owing to the powerful odour which arises from their decomposing bodies.

Our shores are remarkably poor in Hermit-crabs. Our largest and commonest local species is *Eupagurus novae-zealandiae.*

Of the long-tailed decapods, the marine crayfish *Palinurus edwardsii* leads the way; though this is of course not exactly a littoral species.

The commonest "shrimp"—the only one used commercially—is *Palaemon affinis,* common in rock pools, etc., and is widely spread over the Southern Hemisphere; while the smaller *Pontophilus australis,* of a uniform sandy grey, is equally common.

Betœus aequimanus, a jumping shrimp, is common under stones and amongst weed between tide marks; its colour appears to be variable, being uniform brownish-red or olive green, according to its surroundings.

The Schizopods are locally represented by an endemic genus *Teganomysis;* while *Nyctiphanes australis* is at times abundant in the harbour.

Amongst the Amphipods, *Orchestia gammarellus* is common under wet stones and weeds between tide marks; and *O. guoyana,* our commonest "shore hopper," lives under old seaweed, where it digs its burrow in the sand, above tide mark.

Species of *Hyale, Melita,* and *Atylus* are also to be found pretty commonly in rock pools. The pelagic "Barrel-shrimps" *(Phronima),* in their transparent jelly-like barrels, are very frequently thrown up at St. Clair.

A considerable number of Isopods are known in this locality, of which the following is a small selection:—*Idotea ungulata* and *I. elongata* are very common all round the coast; the former is green, and occurs usually on green seaweed; the latter is brown. It is unknown how far, if at all, these species can change their colours to suit their environment. *Lygia novae-zealandiae* is also very abundant under stones, etc., on rocky shores; while *Actœcia euchroa* occurs on sandy beaches at high-water mark; it is light grey, with irregular black markings.

Dynamena huttoni, *Nesea canaliculata*, *Æga novae-zealandiae* are common in shallow water, while *Sphaeroma gigas*, and *Isocladus armatus* occur in rock pools.

The rocks in suitable places exposed to the rush of the tide, such as at Lawyer's Head, on the Ocean Beach, and in some parts of the harbour, are covered with small Cirripedes *(Chamœsipho columna)*. A large species, *Balanus decorus*, with pink valves, occurs in clean water.

Of pedunculate forms, *Pollicipes darwini*, with coarse, thick, rough valves, with black integument; and *P. spinosus*, with smoother and thinner valves and brown integument, occur along the coast; each is about three-quarters of an inch long, with a short stalk.

On some of our beaches the shells of the Brachiopods, *Rhynchonella nigricans* and *Terebratella cruenta* are occasionally met with.

The Sipunculids are represented by *Physcosoma annulatum* and *Dendrostoma acneum*.

Mention must be made of certain Spiders that have been recorded as being found on shore between tide marks, "and on rocks fully exposed to the swell and battery of the South Pacific Ocean," but capable of walking into the sea; some having their nests under water. Mr Goyen, who described four species belonging to different genera (*Amaurobioides*, *Robsonia*, *Habronectes*, *Marptusa*), notes that this is "the only country in which such spiders have been found."

Of the MOLLUSCA, perhaps the most interesting is the genus *Amphibola*; it is a pulmonate which has secondarily returned to the primeval home of its ancestors. *A. avellana* may be seen in countless thousands crawling sluggishly over the mud banks left at low tide all round the harbour. The genus is in every respect an interesting one, as it is almost, if not wholly, confined to our shores. It used to be eaten by the Maoris, as is evidenced by its occurrence in the middens along the coast.

The limpet-like *Siphonaria*—another pulmonate, but possessing gills in its lung chamber—is also represented by one or two species, clinging to stones along the harbour side, while the shell-less *Oncidiella nigricans* may be met with, at times, in the under sides of the same stones.

Living in similar situations are various species of Chitons: the commonest among them is, perhaps, *C. pellis-serpentis*, the colour of which is of various tints of brown and grey. Almost equally common on our harbour side is the large dark green *C. quoyi*, with smooth shells. *Acanthochites* (represented commonly by *A. zealandicus*) is recognisable by its tufts of hair-like spicules, arranged along each side of the back. A smaller form is *Ischnochilon longicymba*, very variable in the details of colour and pattern; while *Onithochiton undulatus* is purplish in colour.

Amongst the commoner gastropod shells in our locality are various species of *Patella*, *Purpura*, *Littorina*, *Monodonta*, *Gibbula*, *Euthria*, *Comminella*, *Trochus*, *Turritella*, *Turbo*, *Siphonalia* (*Neptunea*), and others; while *Emarginula* *striata*, *Scutum ambiguum*, *Haliotis rugoso-plicatus*, *Voluta pacifica*, *Ranella argus*, and *Astralium* may be met with on the beaches.

Of the Lamellibrachs, *Chione stutchburyi* is perhaps the commonest of all; while species of *Mactra*, *Mesodesma*, *Tellina*, and other common genera are, of course, abundant; as well as *Crenella impacta*, *Myodora striata*, *Soletellina nitida*, *Psammobia lineolata*, *Mytilus latus*, *edulis* and *magellanicus*, *Ostrea purpurea*, and others; and a rock oyster also occurs in numbers in the harbour. Boring into the soft rocks at Moeraki and elsewhere, we find the Pholads *(Barnea similis*, and *P. tridens)* in numbers; while the interesting *Solenonya parkinsoni* has been obtained in the harbour.

Two CEPHALOPODS are common, at certain seasons, drifting up the harbour and being thrown up on shore to die in considerable numbers, especially at Anderson's Bay—viz., *Octopus maorum*, and *Todarodes sloanii*. Mention may be made of certain gigantic cuttles that have been, from time to time recorded from the warmer coasts of our islands—viz., species of *Architeuthis*, measuring 18 feet in length, or, including the longest arms, 53 feet over all.

Only a comparatively few OPISTHOBRANCHS or "sea-slugs" have been recorded from the shore—viz., species of *Tethys*; a handsome brown *Goniodoris castanea*; and an orange *Archidoris nannula*; while a very fine fellow, measuring sometimes six inches in length, violet above and orange below, occurs in 20 fathoms off the coast, and is dredged up in quantities by the trawlers: this is *Archidoris violaceus*. (The identifications have been communicated to me by Dr R. Bergh.)

Turning to the ECHINODERMS, our commonest starfish is the small, short-armed *Asterina regularis*, which is abundant in all rock pools near low water mark. It is very variable in colouration and in the number of its arms, which are typically five; the colour is usually a mottling of blue or green with brown or yellow of various tones; but it may be reddish or even nearly uniform in one of the above tints.

Asterias scabra is not unfrequent on rocky coasts such as at Puketeraki; it is a handsome starfish, attaining a size of 18 inches across, with seven long and spiny arms. It is usually of bluish—or greenish-brown variagated with reddish-brown; the tube feet are bright red.

Another large species, with eleven or twelve arms, is *Asterias calamaria*, brownish in colour; but, curiously enough, the individuals that live in deeper water are blue (Farquhar).

The fine *Astrogonium abnormale*, covered with large plates, with heavy marginals, is often found on the Ocean Beach; and is brought up in considerable numbers by the trawler.

Of the "Sea-eggs" (Echinids) our commonest and largest is *Evechinus chloroticus*. Its interest lies, chiefly, in its occurrence here and at Fiji; but not on the Australian coasts.

The Spatangids are represented by *Echinocardium australe* (?), and the Clypeastrids by the flat cake-urchin, *Arachnoides placenta*, which is very common on sandy beaches—as at Warrington.

Our commonest Brittle star is *Ophionereis schayeri*, which is purplish-black to grey, with bands of lighter grey or yellow on the arms.

Amongst the Holothurians, a very common little species is *Chirodota dunedinensis*, which, at certain seasons, is found abundantly under stones along the harbour side; its transparent body wall is pinkish-yellow.

The peculiar *Caudina coriacea* is occasionally washed ashore after storms; while below tide marks *Stichopus mollis* is very abundant; it is our largest species, attaining a length of six or eight inches; its colour is a mottling of brown and yellow.

The ASCIDIANS or "Sea Squirts" have not yet received attention; the largest and most noticeable species is the long-stalked *Boltenia pachydermatina*—the "Sea tulip" as it is sometimes called. The body, which is attached by a long, tough, white stalk, is some three or four inches in length when distended; pale pink and white in colour, with deep red margins to the apertures; it may be seen growing in numbers on the piles of the wharf at Port Chalmers, and elsewhere on the harbour side.

Species of red *Styela*, and a number of unidentified compound ascidians occur on the rocks off Quarantine Island.

Perhaps the most generally interesting animal that has been collected in the harbour—and that only on one occasion—is a species of ENTEROPEUNST *(Dolichoglossus)* the only representative of the genus hitherto described from the Southern Hemisphere, and apparently related to a Japanese species.

Although no ACRANIATE has been collected in the neighbourhood, mention must be made of the Lancelet, *Asymmetron hectori*, two individuals of which were collected many years ago on the coast of the North Island. It is quite distinct from the Australian species.

It would occupy too much space to enumerate all our local Fishes; but the following is a list of those that are commonly to be seen in the fish shops, obtained either in the harbour or off the coast by line or trawl. The "frost fish" is never caught, but occasionally drifts ashore, tail downwards and head upwards:—

Fam. Percidæ.			
Polyprion prognathus,	locally	termed	Groper
Arripis truttaensis	,,	,,	Kahawai (rarely)
Fam. Sparidæ.			
Pagrus unicolor	,,	,,	Snapper (rarely)
Fam. Cirrhitidæ.			
Chilodactylus macropterus	,,	,,	Tarakihi
Latris lineata	,,	,,	Trumpeter
Latris cilaris	,,	,,	Moki
Fam. Trichiuridæ.			
Lepidopus caudatus	,,	,,	Frost-fish
Thyrsites atun	,,	,,	Barracoota
Thyrsites prometheus	,,	,,	King-fish
Fam. Carangidæ.			
Caranx georgianus	,,	,,	Trevalli
Caranx trachurus	,,	,,	Horse-Mackerel.
Seriolella brama	,	,	(?) Warehou
Seriola lalandii	,,	,,	King-fish (of the North Island).
Fam. Trachinidæ			
Percis colias	,,	,,	Blue cod
Notothenia maoriensis	,,	,,	Maori chief, or Flathead

Fam Cottidæ.			
Trigla kumu	locally	termed	Gurnard
Fam. Mugilidæ.			
Agonostoma forsteri	,,	,,	Sea Mullet or Herring
Fam. Labridæ.			
Labrichthys bothryocosmus	,,	,,	Spotty
Coridodax pullus	,,	,,	Butter-fish
Odax vittatus	,,	,,	Kelp-fish
Fam. Gadidæ.			
Merlucius grayi	,,	,,	Haddock
Pseudophycis bacchus	,,	,,	Red cod
P. breviusculus	,,	,,	Whiting
Fam. Ophidiidæ.			
Genypterus blacodes	,,	,,	Ling
Fam. Pleuronectidæ.			
Rhombosolea monopus	,,	,,	Flounder
,, *flesioides*	,,	,,	Yellow-belly
Peltorhamphus novæ-zealandiæ		,,	Sole
Pseudorhombus scaphus	,,	,,	Brill
Fam. Scombresocidæ.			
Hemiramphus intermedius	,,	,,	Gar-fish
Fam. Gonorhynchidæ.			
Gonorhynchus greyi	,,	,,	Sand-eel.

In addition, the quaint Scorpaenid, *Agriopus leucopoecilus*, called the "pig-fish," from its prominent snout, is often to be seen in hundreds in the harbour, coming right up to the wharves.

The little blennies belonging to a genus *(Tripterygium)* found elsewhere only in the Mediterranean, and the sucker fish *(Diplocrepis)* may be seen in rock pools.

The beautiful and rare oar-fish or ribbon-fish *(Regalecus glesne)* has on more than one occasion been cast up on the beaches, or caught in shallow water in the neighbourhood.

Of Sea Birds, the commonest frequenters of the harbour are black-backed gull *(Larus dominicanus)* and the neat little red-billed gull *(L. scopulinus)*; and with them a tern *(Hydroprogne caspia)* is frequently associated. On the coast, or at a little distance out at sea, one may see the gannet *(Dysporus serrator)*, and three species of albatross *(Diomedea exsulans, D. culminata,* and *D. melanophrys)*; while several species of shag or cormorant *(Phalacrocorax)* occur both on the coast and up the rivers; one species, indeed, nests at the Otago Heads.

At the proper season thousands of "mutton birds" *(Puffinus griseus)* make their way down the coast to Stewart Island; this petrel and others are highly prized by the Maoris, who make annual expeditions to capture them and preserve them for future use.

A penguin *(Eudyptes pachyrhynchus)* may occasionally be found on some of the beaches.

Finally, specimens of the hair-seal *(Eumetopias hookeri)* occasionally visit the beaches in the immediate neighbourhood of the town.

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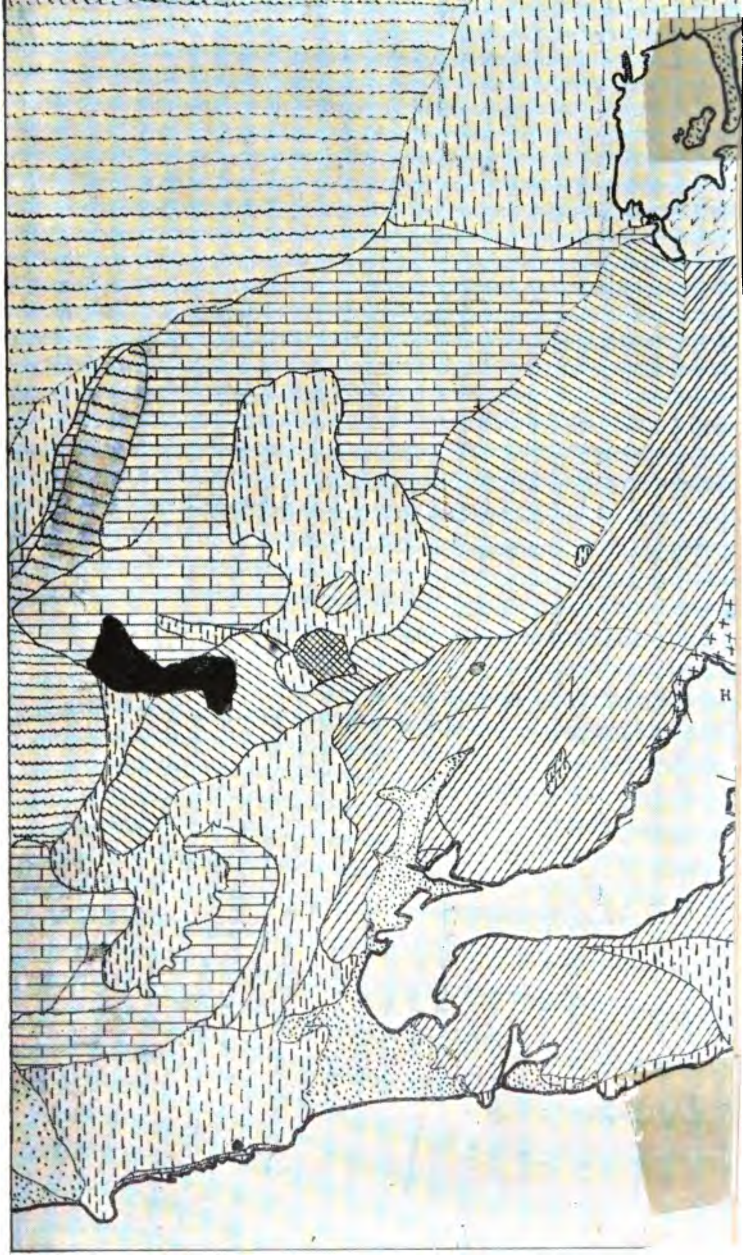
GEOLOGY.

By Patrick Marshall, D.Sc., Lecturer on Geology, Otago University.

The provinces of Otago and Southland have been submitted to geological examination rather more thoroughly than most districts of the colony, and their general structure is well known and understood, though the details in almost every locality require much closer attention than they have hitherto received. It is probable that in this comparatively small area nearly all the recognised periods of geological time are represented by sedimentary formations, though the rarity of fossils in the more ancient of the rocks, and the complete metamorphism to which they have been subjected, have, up to the present, necessitated more conjective than scientific accuracy in assigning to them their probable age. Not only is great variety evidenced in the age of our rocks, but their petrographical nature is no less varied. We have plutonic representatives covering a large area of the West Coast, ranging in their nature from acid types through the various classes to the most basic known, and these last are of extreme mineralogical interest because they are the source of the curious nickel iron alloy awaruite, a substance unknown in terrestrial deposits before this discovery was made. The central portion of the province is entirely composed of metamorphic rocks, for the most part so changed that all trace of their original nature has been completely obscured. Mica schist greatly predominates, but other schistose rocks occur, and everywhere they are



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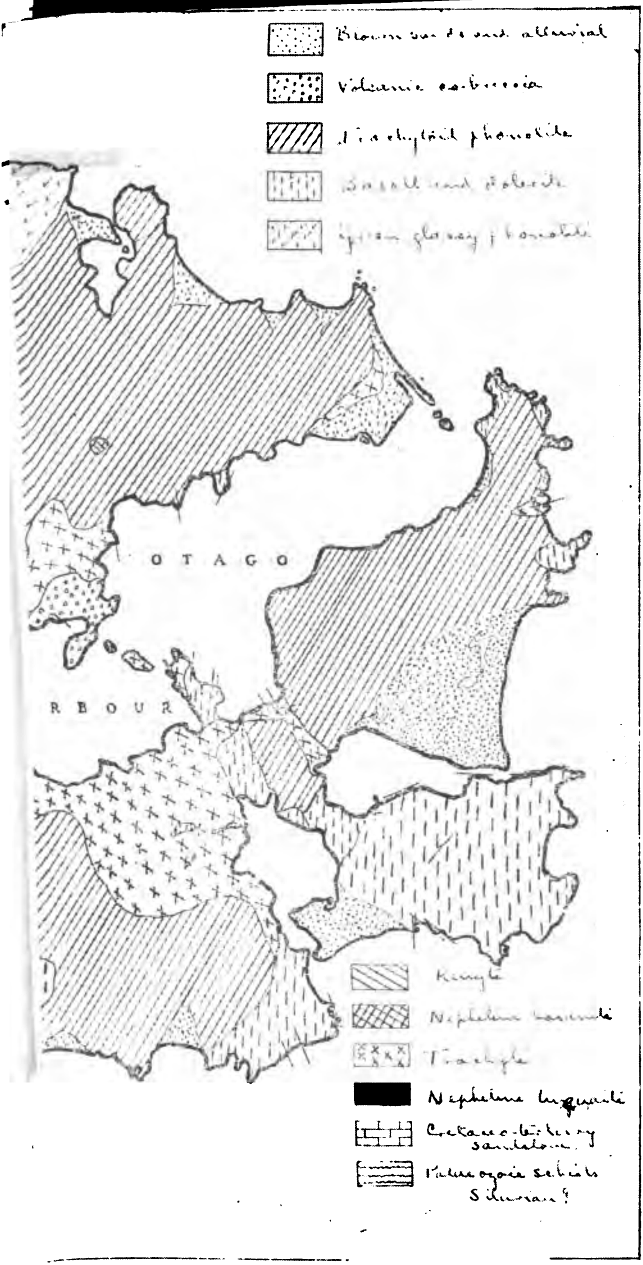

EDIN AND ENVIRONS.

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marked with ribs, seams, and lenticles of quartz that are probably the nidus of the gold which, released from its parent rock by the constant attrition of streams and the chemical action of air and water, has become concentrated in old and recent gravels, from which modern industry has reaped rich harvests and is still obtaining respectable yields. Larger quartz masses contain sufficient gold to render milling processes profitable, and in places scheelite and antimony ore can be mined, and cinnabar occurs in small quantities. The geological age of these schists is still a matter of doubt. Sir James Hector thinks that they are for the most part Silurian, but Captain Hutton, in his latest publication, has given reasons for thinking them of much greater antiquity, and he even places them in the multitudinous, irregular, shadowy ranks of Archæan formations, deposited at a time when, for all we know, no life was.

The schistose mass of rocks strikes N.W. and S.E., reaching the eastern coast near Dunedin. To the N. and S. of this mass is found a vast assemblage of younger sediments, compact and hardened, sometimes almost metamorphic, but in nearly all cases originally sandstones. Here and there they contain fossils, sometimes abundantly, as in the Hokonui Ranges. By the New Zealand geological survey these have been placed in various periods from carboniferous to jurassic. Fossils lately found by Professor Park may necessitate a complete revision of this classification, and we await their identification and description by Professor Bohn with much interest, if not anxiety.

Formations of this age are, perhaps, of more interest than those of any other in the Southern Hemisphere, for in the Permian rocks of South Africa, East Australia, and India, have been found certain formations whose nature almost compels acceptance of the statement that they were formed by ice action. In our own rocks of corresponding age there are also some deposits that deserve more attention than they have hitherto received before it can be definitely stated that they were or were not of glacial formation.

Associated with the rocks in all these countries are certain plant impressions that show that the vegetation was in its main characters almost identical on the three continents. It has, therefore, been supposed that land connection really existed between them. This land, which probably extended over a great portion of the present Indian Ocean, constitutes the so-called ancient Gondwana Continent.

This continent is supposed to have existed for several geological periods. During these periods estuarine deposits were formed in the New Zealand area. They were apparently laid down in estuaries of large rivers draining a continent that extended to the north and west. Plant fossils and impressions are abundant, and so far as they have been examined they show that the vegetation in New Zealand was at that time similar in its main characters to that of the Gondwana Continent. The whole subject, however, especially that part of it relating to New Zealand, requires the expenditure of much time and research, and it is to be hoped that the newly-organised Geological Survey may allow some of its officers to examine our deposits and fossils of this age with the object of elucidating the problem, which is one of the most fascinating in the whole field of geological research in New Zealand.

Fringing the eastern coast of Otago, and filling the older hollows in many interior regions is found a nearly complete series of older and middle tertiary deposits. The older of these are classed as cretaceo-tertiary by our Geological Survey, but Captain Hutton thinks that a clear line can be drawn between the cretaceous and tertiary formations. Economically these are more important than all the rest of our rocks combined, for they contain thick beds of coal. The coal is nowhere in Otago completely bituminous, but for the most part consists of superior varieties of brown coal, very suitable for household, and to some extent for steam-raising, purposes. The Geological Survey places all the coal seams in their cretaceo-tertiary age, but Captain Hutton considers some of them of cretaceous, others of oligocene age. It is probable that time will show the substantial accuracy of the latter classification. Many of the coal seams crop out quite close to the south of Dunedin. During the tertiary age volcanic action was in evidence, submarine outbursts occurred to the north near Oamaru, and the present site of Dunedin was the theatre of stupendous terrestrial explosions. The whole of Otago Peninsula and a long fringe along the coast of the adjoining mainland—rugged and picturesque country—are the product of this volcanic energy. The most noticeable feature of the more recent periods of geological history is the evidence of the prevalence of more severe climatic conditions over the area of land at present above sea-level than exists now. The cause of this, again, is the subject of dispute. Sir James Hector and Sir Julius von Haast explain the greater extension of the glaciers as due to the large area of gathering ground for snow and ice before the elevation of our mountains was reduced, and the area of high country diminished by the destructive effects of weathering actions and by the formation of the profound river channels that now dissect it in all its regions. Captain Hutton's explanation is that the whole country was in late tertiary times elevated some 2000 feet. The greater precipitation thus induced, and the greater area of country above the snow line, would, in his opinion, be sufficient to account for all the observed phenomena. Independent evidence in favour of this view is not wanting.

Whatever the cause of the great glacial extension, its affects are very noticeable over the whole interior of Otago. At no time was there an extended ice sheet as in Western Europe and North America, but glacial terraces, roche moutonnees, and moraines are found everywhere in the major drainage channels. To the erosive action of the ice is generally ascribed the formation of the lake basins of Otago. Though this theory of lake and fiord origin is now strongly opposed by all the best known continental geologists, there can be no doubt that Lakes Wakatipu, Hawea, Te Anau, and others have been filled in comparatively recent times by huge ice sheets, for the glacial terraces, huge terminal moraines, and rounded rock contours prove this conclusively. Soundings recently completed have shown that Lake Wakatipu possesses in perfection the trough-shaped flat-bottomed form that is always considered the most characteristic feature of glacial valleys. It must therefore be admitted that, whether or no the formation of the basin is due to ice erosion, its ultimate shaping is certainly the result of the movement of an ice stream. Ten miles to the south of Dunedin there is a large glacial moraine forming the western flank of Lake Waihola, but despite various observations to the contrary, there is no evidence that the high volcanic hills round Dunedin ever formed the support of nevee for the supply of glacial ice.

The structural geology and physiography of the region are still less known than its stratigraphical nature. The structure of the mountainous region of the wild west no one has yet attempted to work out in detail—in fact, there are still unexplored blanks there, and those geological explanations that have been made have shown a continuous succession of plutonic rocks and gneisses apparently with a constant inclination.

Though the centre of the province runs from N.W. to S.E., an anticlinal axis much eroded; perhaps, a rudimentary peneplain, which subsequent elevation has caused to be eroded again into tumultuous mountainous country. On its northern and southern flanks the rocks are much folded, but the details of these as shown in the Hokonui Mountains to the south, and the Kurow Mountains to the north, are not yet satisfactorily known. Near the West Coast this axis describes a sharp curve to the N.E. and continuing an uninterrupted course forms the Southern Alps. The lake basins and the fiords are deep, steep-sided hollows, ascribed by all observers to a glacial origin.

The river valleys have, according to Captain Hutton, suffered great change in direction within geologically late times. The ice masses flowing in the deep valleys during the period of greater glacial extension have, in many instances, formed huge moraines which, after the melting of the ice, constituted barriers to the passage of rivers, and an overflow of the lake thus caused has, in many cases, passed over saddles into valleys previously small and unimportant. Thus the original drainage of the present Lake Wakatipu basin formerly flowed past Kingston and Athol into the Waimea Plains. The moraine that now blocks this outlet has caused an overflow at Frankton, which remains still the outlet of this lake.

The coast line of the region is in places steep and abrupt, especially on the West Coast, where a combination of high country, hard rocks, a heavy sea, and abundant rainfall have together produced scenic wonders that are the glory of New Zealand. On the East Coast there is bold scenery and a series of battling cliffs where the hard volcanic rocks of Otago Peninsula face the ocean, and there are similar features where the mesozoic rocks of Nugget Point jut out seawards, but elsewhere the soft tertiaries form the land margin and a quieter type of scenery prevails.

The geology of Dunedin deserves at the present time rather more notice than can be given in the course of a general description of the province.

The basement rock of the district is mica schist, which reaches the sea coast at Brighton about six miles south of St. Clair. It extends thence north-east in an irregular curved line, passing about four miles inland from Dunedin. As previously remarked, Sir James Hector, on petrographical grounds, correlates the schist with certain formations in the Nelson province that stratigraphically can be proved to be of Silurian age. Captain Hutton, relying on intrinsic evidence in the schist itself, concludes that its age is probably Archæan. In late mesozoic or early tertiary times a prolonged period of denudation ended with a complete removal of all the sediments that, during intervening periods of geological time, had been deposited on the surface of the schists. A depression then occurred, and on the seaward border of the land was deposited a series of sandstones. They consist entirely of quartz grains derived from those portions of the schist that remained above the sea-level. The depression was evidently slow, for on the surface of the schist swamps were first formed, and in these a luxuriant vegetation grew whose remains have since been compacted into seams of brown coal. The depression became more rapid and the marine deposits formed became calcareous, and from them fossils can now be obtained. These are chiefly brachiopods, echinoderms and mollusca, but it is seldom that good specimens have been obtained. Higher forms of life inhabited the seas, for specimens of a small belemnite actinocamax are found near Brighton, as well as crabs and some fairly good remains of a toothed whale—squalodon—have been obtained. A greater depth of water still was reached, and green sands were formed. These contain phosphatic nodules, and sharks teeth can be found in them in some numbers. It has been previously remarked that the exact age of the beds formed during this period of depression is like many other questions of New Zealand geology—a matter of dispute. Sir J. Hector considers that the period bridged over the interval between the cretaceous and tertiary of European geology, but Captain Hutton, who has carefully worked out the affinities of the fossils, thinks they were contemporaneous with the European oligocene. These formations are now found on the coast line between St. Clair and the Kaikorai mouth, and in the valleys of all the streams behind Dunedin that have cut through the overlying volcanic rocks.

Rather rapid elevation followed this depression, for no thickness of shallow water beds is found on the surface of the green sands. The loose deposits were easily eroded, and large valleys and cliffs were already formed in them when the violent cataclysm occurred to which the Otago Peninsula owes its present salient features.

Volcanic action of an extensive and energetic nature took place, and huge lava streams flowed down the steep valley sides and formed huge lava lakes in the bottoms. Showers of ash and scoria were shot out from the craters and formed beds of fragments on the lava surfaces. That the volcanic action was intermittent is shown abundantly by the old baked soils so frequently found between two successive lava streams. Nor was the region in the midst of all these convulsions a desolate one. In the sheltered beds of streams, and in tidal estuaries, beds of fine mud from the volcanic hills were deposited, and in these accumulated leaves of plants in great number and variety. Occasionally the vegetable accumulation was sufficient to form small seams of coal. So perfectly have these been preserved that detailed work will in the near future be able to reconstruct the forests of this volcanic age. So far as our knowledge of them goes at present we have reason for thinking that the New Zealand forests of those days contained oaks, elms, and birches, as well as trees now characteristic of the present New Zealand flora.

The actual products of the volcanic eruptions show rather an astonishing variety. Apparently the oldest lava was a basic and coarse dolerite, which now covers a large portion of the Peninsula near Cape Saunders. Then followed a trachyte, which now forms a large part of the Peninsula near Portobello. This rock is almost pure felspar. Basalts and nepheline basanites followed; then a flood of highly liquid alkaline lava that, issuing from many points, spread over nearly the whole area. It solidified into a fine-grained dark-green trachytoid phonolite. The nearest masses of this to Dunedin are Maori Hill, Roslyn, and Signal

Hill. These contain cossyrite as well as aegerine. Next a lava of a peculiar type was ejected. This is similar to the Kenyte of Gregory, so called from its occurence on Mount Kenya in East Africa. It contains rather abundant crystals of sodalite, a mineral of rare occurence in lavas. In our district it occurs not infrequently in basanites and other rock types, as well as Kenytes. Nepheline crystals of large size often occur in it as well as in the basanites. This rock now bounds both sides of the Leith Valley. Finally more basalts were ejected, though no large lava streams seem to have flowed.

During the throes of volcanic action many rents were formed, and into them were squeezed molten rocks that have formed solid dykes. Many of these are tinguaite, and in some of them—notably in one at Portobello and another at the Cliffs—are nepheline crystals three-quarters of an inch in diameter. Dolerite, phonolite, and basalt dykes are also found in number. It will be seen that these radiate from a point near Port Chalmers, so we are perhaps justified in concluding that this point was the scene of some of the most violent activity. The structure of the coarse tinguaite on Flagstaff and Pine Hill indicates that these, too, were points of eruption.

At Port Chalmers itself there was a peculiar phase of activity. The rock here consists of a breccia, often coarse and composed of fragments of many volcanic rocks much rounded. This must have been the result of violent steam eruptions, which time and again threw the pieces of rock into the air in much the same way as Waimangu does now, but on an immensely larger scale.

Two plutonic masses occur in the district, but their outcrop is limited. One, a diorite, forms the Bell Hill near the Dunedin Railway Station; the other, a nepheline syenite, is found near Portobello.

Decomposition of the rocks has not produced a very plentiful crop of secondary mincrals. Natrolite at Caversham, anolcite and calcite at Portobello, arragonite at Port Chalmers, hyalite at the Cliffs and elsewhere, with a little chabazite and halloysite make up the total sum.

After the volcanic eruptions the land for a time remained elevated apparently as much as 1500 feet above its present level. Streams flowing north-east and south-west from Port Chalmers eroded the valleys forming the lower and upper harbours respectively. Other streams formed the valleys now called Hooper's and Papanui Inlets.

Depression again followed, and the land sunk to about a hundred feet lower than now. The depression did not last long enough for any extensive deposits to be formed, but the sea eroded terraces on the seaward face of the land and the deep drowned stream valleys partly silted up. An elevation to the present height followed, and the northward drift of the marine current brought with it a continuous stream of sand which, arrested by the northern head of each inlet, has with the aid of the wind formed the sand flats at Ocean Beach, Wickliffe Bay, and elsewhere. The sand blocked the natural outflow of the Otago Harbour at St. Clair, and the waters overflowed the narrow watershed near Port Chalmers into the lower harbour; and the constant flow of the tides has deepened the connexion thus formed.

Much of the foregoing, especially the succession of lavas in this district, is to some extent speculative, and though much study has been spent in the field and laboratory the surface decomposition of the rocks and the thick growth of vegetation

often obscures those facts that would be most valuable. Thus some uncertainty still exists, but it is evident that the district when fully worked out will afford one of the most valuable instances known of the actual succession of rocks in a volcanic district possessing some of the rarer types of lava. The results obtained here by future study may be expected to be of importance in relation to magmatic differentiation.

In the small geological map printed in this handbook an attempt has been made to give the boundaries of all the major rock formations of the district. It cannot be pretended that this has been done with anything more than a rough approximation. Difficulties of no ordinary magnitude are encountered on every hand. The surface rocks are nearly everywhere covered by a thick mantle of decomposition products by which their true nature is often completely obscured. A thick growth of vegetation hides the rock formation, and the loose boulders lying on the surface in such hilly country more often deceive than aid in gauging the nature of the true base rock. The mountainous character of the district renders the outlying portions rather inaccessible. Finally even the practised eye may often be misled by the appearance of the actual specimens, for some of the rocks almost totally different in chemical and mineralogical composition may, to the unaided eye, appear quite similar. Hence deductions based on field identifications have sometimes to be completely revised after laboratory examination of the specimens.

The numerous volcanic dykes marked on the map include rocks varying in nature from basanite to a fresh diahase. Those of an alkaline nature appear to radiate from the neighbourhood of Port Chalmers.

COMMERCE AND INDUSTRIES.

BY GEORGE FENWICK.

I. COMMERCE.

THE EARLY DAYS.

The statistical records of the earliest days of Otago are fragmentary and incomplete; indeed, until the arrival of the first pioneer settlers in 1848, it may be said that there were no statistics of the trade that was carried on. And yet it must have been considerable, for from the earliest years of the century, along the coast line from Waikouaiti to Bluff and at Stewart Island, were dotted numerous whaling stations that were scenes of busy activity. These even extended round to the western coast as far as Dusky and Chalky Sounds. Official records also establish the fact that shipbuilding had its commencement at Waikawa as early as 1832, about which date a handsome craft of 140 tons was built at that roadstead by a mechanic named Peter Grant. The official records of the parent colony of New South Wales show that a large part of the trade between Sydney and New Zealand was with the South Island. From as early a period as 1805 up to 1848 the whaling and sealing industries, and a certain amount of trade in flax fibre with the Maoris, were steadily prosecuted, and the aggregate volume of trade in those industries must have been of considerable dimensions. It is specially interesting to note that the trade in flax took practical shape as early as the year 1813, when Sydney merchants sent two men over to Foveaux

Strait to report on the value of flax fibre. Five years afterwards Sydney imported 60 tons of the material, which was valued at £2600. The flax industry seemed to have progressed but slowly, however, until the years 1830 and 1831, at which periods the value of flax imported to Sydney from New Zealand was £19,603 in the former year, and £23,919 in the latter. The respective proportions for the North and South Islands cannot, however, be stated separately. The trade appears afterwards to have languished, partly due to difficulty in inducing the Maoris to dress the fibre, and partly from the dirty state in which it was shipped.

Of the trade in whale oil and sealskins, the Sydney records give numerous particulars. At as early a date as 1805 the Sydney Shipping Register reports the arrival of a vessel with 5000 sealskins. In 1809 the Sydney Gazette notifies the arrival of a vessel with 10,000 fur sealskins. The master reported having passed through "a newly discovered strait, which cuts off the South Cape from New Zealand"—subsequently Foveaux Strait,—so that, in all probability, part, if not the whole, of the valuable cargo came from Otago coasts. A week later the arrival of two vessels from Foveaux Strait, one with 12,000 skins and the other with between 13,000 and 14,000, was reported; while another vessel was reported at the Bay of Islands with 20,000 sealskins, which she expected to increase to 30,000 from her gang of men left at the Bounties. And so the records proceed right on into the thirties, with varying quantities of sealskins, seal oil, and flax, until in 1838 there seems to have been a great drop in the volume of trade.

Of the whale fisheries, Preservation was the first station in Otago, and was established in 1829, and up to 1836 yielded a total of 1146 tons of oil, valued for export at £1200, but in England at £36,000. The other stations were Awarua (Bluff), which between 1838 and 1843 yielded 385 tons; Oreti (1838-9), 120 tons; Aparima (1839-1842), 331 tons; Toi-Tois (1835-6), 30 tons; Waikawa (1838-40), 93½ tons; Tautuku (1839-1843), 245 tons; Matau (1838), 25 tons; Taieri (1839-1841), 93 tons; Otakou (1833-1839), 1472 tons; Waikouaiti (1837-1843), 448 tons; Moeraki (1837-1843), 44½ tons. Besides the oil there was a combined output of whalebone during these periods of about 36 tons.

It is not possible to trace the growth of Otago's trade with any pretension to even approximate accuracy during the years 1843 to 1848, but at the latter date the pioneer settlers had made a start in their new home, and in the course of the two following years were beginning to make headway, in a modest kind of way, in the development of trade.

The following table gives the volume of imports and exports for the Province of Otago for the years 1848 to 1860:—

YEAR.		IMPORTS.	EXPORTS.	CUSTOMS REVENUE.
1848	.. ..	£11,869 0 11	—	£824 19 4
1849	.. ..	8,932 17 0	£219 0 0	1,835 5 9
1850	.. ..	13,819 18 0	782 10 0	1,8[illegible]2 6 11
1851	.. ..	13,654 3 0	546 2 0	2,197 3 10
1852	.. ..	15,390 17 6	84 0 0	2,386 17 10
1853	.. ..	11,074 5 0	770 0 0	2,276 15 0
1854	.. ..	43,692 7 0	6,481 19 0	5,781 14 10
1855	.. ..	44,545 11 0	24,182 15 0	4,375 11 0
1856	.. ..	6[illegible],310 18 9	25,737 6 9	5,546 14 0
1857	.. ..	77,833 19 0	25,266 15 6	8,550 2 10
1858	.. ..	110,225 5 0	47,344 6 8	11,652 14 1
1859	.. ..	243,871 0 0	83,720 0 0	18,742 6 1
1860	.. ..	325,162 0 0	80,268 0 0	31,769 17 7

When the result of the people's energy in these earlier years is set down in bare figures, no doubt the volume of trade has an insignificant look, and until the discovery of gold in 1861 Otago was hardly entitled to claim that it was much more than a self-contained community of pioneers in a new land. With the discovery of gold in Tuapeka by Thomas Gabriel Read in May, 1861, however, a new era dawned for the young settlement. Owing to the enormous influx of population from Australia—a vigorous, pushing type of business man taking possession of the trade of the town, and thousands of stalwart diggers overrunning the country and founding flourishing townships in the goldfields they discovered—Dunedin quickly rose to considerable importance as an active and prosperous centre of business life, as will be seen from the detailed figures of the trade of the province given in the following table:—

IMPORTS AND EXPORTS 10 YEARS FROM 1861 TO 1870.

Year.	Imports.	Exports.	Customs Revenue.
1861	£8 9,783	£844,149	£31,769
1862	2,343,661	1.766,057	180,048
1863	4,291,075	2,661,416	326,587
1864 . ..	2,965,647	2,117,039	253,195
1865	1,711,113	1,492,607	228,593
1866	1,818,302	1,201.692	—
1867	1,786,527	1,226,602	253,167
1868	1,788.145	1,818,967	247,240
1869	1,726,783	1,329,890	245,252
1870	1,498,256	1,457,215	230,485
	£20,779,242	£15,418,734	—

The increase in the commerce of Otago which took place in the years 1861 and 1862 is very marked, and especially the rise in the imports from British Colonies—principally Victoria. The total value of the Province's imports in 1860 was:—From the United Kingdom, £143,814; from British Colonies, £181,348;—total, £325,162. In 1861 the figures were as follows:—From United Kingdom, £161,333; from British Colonies, £770,057;—total, £931,890. In 1862, the imports to Otago reached the enormous total for so young a settlement of £2,343,661, of which goods to the value of £450,630 came from the United Kingdom, of £1,595,183 from British Colonies, and £37,709 from Foreign States.

The exports for the same years likewise show a great development. In 1860 the figures were —To the United Kingdom, £28,672; British Colonies, £26,817; Foreign States, £37;—total, £55,526. In 1861—To the United Kingdom, £104,258; to British Colonies, £748,202; to Foreign States, £238;—total, £852,698. In 1862 —To the United Kingdom, £229,287; to British Colonies, £1,536,437; Foreign States, £333;—total, £1,766,057. Of this sum the value of gold exported is set down in the statistics as £1,543,623; the value of all other articles of export therefore being £222,433. In 1863, in like manner, while the value of the total exports was £2,661,416, gold contributed no less than £2,380,750.

It is interesting to note that in March, 1864, the banks then doing business in Dunedin competed for the Provincial Government's account, with the result that the tender of the Union Bank of Australia was accepted. As to the overdraft that the bank would allow the Government, the successful tenderers considered it unnecessary to fix any amount, although £30,000 was mentioned as a sum the Government could rely on in any case; the rate of interest to be 6 per cent., with an allowance of 5 per cent. on the daily balance of any Government deposits. The Bank of New South Wales proposed to charge 7½ per cent., and the Bank of New Zealand "3 per cent. under current rates"— the current rate at that time being 10 per cent.

It will be seen that the greatest volume of trade for any one year in the 1861-1870 decade was in 1863, when the imports to Otago reached the truly extraordinary total of £4,291,075, and the exports £2,661,416—also the heaviest figures of the 10 years. It is also worthy of note that while Otago's imports in 1863 reached the enormous total of £4,291,075, as just stated, the total value of the imports for the whole colony just three years previously was only £1,548,833. By 1870 the value of Otago's imports had decreased to £1,493,256, and that of the exports to £1,457,215. The figures showing the value of the gold exported from Otago during the 10 years are as under:—

GOLD EXPORTS.

1861	£727,321
1862	1,543,623
1863	2,380,750
1864	1,689,543
1865	1,004,163
1866	654,970
1867	623,543
1868	686,596
1869	613,456
1870	660,674
	£10,584,639

A great development of the trade of the province was approaching, as will be seen from the following figures:—

YEAR.	IMPORTS.	EXPORTS.
1871	£1,335,601	£1,585,338
1872	1,898,618	2,117,025
1873	2,275,358	2,170,022
1874	2,835,334	2,044,322
1875	3,036,793	2,060,549
1876	2,861,613	1,925,607
1877	2,398,277	1,980,455
1878	2,975,845	2,112,892
1879	2,896,885	2,016,112
1880	1,988,101	1,939,901
Total for 10 years	£24,002,425	£19,912,923

The imports for the 10 years show an aggregate increase of £3,223,183 over those for the preceding 10 years, and the exports an aggregate increase of £4,494,189. It was an increase not destined to be maintained in the following decade, however, as will be seen from the figures for the latter period, as under:—

YEAR.	Imports.	Exports.
1881	£2,689,276	£1,933,565
1882	2,802,820	2,156,920
1883	2,644,643	2,189,333
1884	2,373 796	2,214,800
1885	2,273,528	1,760,893
1886	1,875,396	1,737,899
1887	1,721,840	1,901,661
1888	1,706,296	1,792,984
1889	1,928,299	2,163,104
1890	1,836,754	2,057,025
Total for 10 years	£21,852,648	£19,908,244

During this decade the imports of the provincial district ranged from £2,802,820 in 1882 to £1,706,296 in 1888; while the exports attained their maximum of £2,214,800 in 1884, with a minimum of £1,737,899 in 1886. Taking the first five years of the decade, the total volume of imports was £12,784,063; and for the second half the total figures had fallen to £9,068,585, or a drop of £3,715,478. The export figures do not show anything like the same variation, the total volume for the first five years being £10,255,551, and for the second half £9,652,743—or a reduction of £602,768. The combined figures, however, show a very marked restriction of trade, arising mainly from a fall in the value of our chief exports and the cessation of the Government expenditure on public works. In no single year of the decennial period until 1889 did the exports of the province balance its imports. In 1888 times were undoubtedly bad throughout the colony: insolvencies were rife, and population was leaving our shores, Otago having to bear its fair share of this unsatisfactory state of affairs. But the tide turned in 1889, when the value of the colony's exports largely exceeded that of the imports, Otago's portion of the increase being £234,865. The price of frozen meat reached a high figure, wool ranged from 5 to 7½ per cent. better values than in the preceding year, and altogether a recovery in industrial and commercial life manifested itself, although the trade of Otago still remained contracted, very largely due to the fact that while up to this period Dunedin had maintained her position as the chief distributing port of the colony, leading commercial houses (largely branches of some of the principal Dunedin firms) were establishing themselves in Wellington and other cities in the colony.

While the colony continued to add to its financial burdens by continued borrowing from the English money lender, it is satisfactory to note that in the last half of the decade private mortgages and other debts decreased enormously, in the three years 1886-1888 no less than five millions of private debts having been paid off, and this pleasant state of things was continued in the succeeding years of the decade. In other respects also evidences of prosperity were not wanting, notably the steady rise in the people's accumulation in the Savings Banks.

Let us now proceed to the 10 succeeding years, with figures as under:—

YEAR.	IMPORTS.	EXPORTS.
1891	£1,758,406	£2,309,980
1892	1,860,733	2,121,900
1893	1,756,429	2,173,995
1894	1,572,960	1,878,894
1895	1,550,719	1,943,659
1896	1,657,824	2,014,896
1897	1,891,484	1,959,065
1898	1,983,116	1,723,465
1899	2,149,567	2,273,875
1900	2,493,906	2,544,437
Total for 10 years	£18,625,144	£20,939,166

A comparison of the figures showing the imports and exports of the period of 10 years from 1891 to 1900 discloses some remarkable fluctuations. The decade opened with a wide divergence between the imports and exports of the province in favour of the latter by no less a sum than £551,574, as will be seen from the figures tabulated above, and in no succeeding year did the exports attain so high a figure until 1900, when they reached the very satisfactory total of £2,544,437, with imports of £2,493,906, or a total volume of trade for the last year of the decade of £5,038,343. It cannot be said that the import figures of the opening year were at all satisfactory to Otago, for while the imports of the whole colony increased by £243,324 over those of the preceding year, Otago's proportion actually decreased by £78,348. This, however, was no doubt largely due to the fact that the distributing portion of Otago's trade was still declining, and locating itself in Wellington and other ports. The development of steam communication with England and other markets was a steady factor at this time in improving the conditions under which the trade of the province was conducted, and it may be said that this has continued with increasing effect until the present day. In 1892 Otago had to some extent recovered her position with respect to the imports of the colony, contributing a value of £102,327 towards the increase for the year. The subsequent figures of her import trade can be seen above, notably the steady increase from 1896. As indicative of the large share in the Colony's trade which fell to Otago in the years 1891 to 1903, the following figures of Customs duty are worth recording:—

YEAR ENDED 31st MARCH.	TOTAL FOR COLONY.	COLLECTED AT OTAGO PORTS.
1891	£1,662,510	£461,118
1892	1,622,414	436,573
1893	1,640,192	431,315
1894	1,665,683	427,706
1895	1,569,787	390,965
1896	1,649,344	401,601
1897	1,815.840	428,576
1898	1,931,630	452,416
1899	1,961,269	461,568
1900	2,102,980	507,208
1901	2,176 990	513,231
1902	2,195,858	493,287
1903	2,331,024	493,170

It will thus be seen that Otago's contribution to the Customs revenue of the Colony was practically a fourth of the whole—the actual percentage being 24.25 over a period of 13 years ending 31st March, 1903. During those years the trade of the provincial district has witnessed a gratifying expansion, the older industries having developed to a wonderful extent, while many new avenues of employment have opened up. These will, however, be dealt with under their proper heading.

As indicating the steady rise in the wealth of the people it may be permissible—although it is a feature that cannot strictly come under the heading of commerce—to quote the Savings Bank returns for the past 10 years. They are to an extent associated with the commerce of Otago, for they tell their tale of steady employment and regular earnings, and these factors, it cannot be disputed, play an important part in the commercial life of a community. The figures are given as follows:—

1891	£604,527
1892	631,545
1893	695,040
1894	760,912
1895	912,206
1896	989,061
1897	1,011,307
1898	1,063,667
1899	1,113,216
1900	1,220,358

The figures show an increase in the savings of the people in the Savings Banks in the provincial district of £615,831 in the decade.

No account of the commerce of Otago would be complete without special reference to the founding and progress of several of the leading joint stock companies which have their headquarters in Dunedin, notably the Union Steam Ship Company, which has exercised a powerful influence on the development of the trade not only of Otago but of the colony, the Mosgiel Woollen Company, and the Westport Coal Company.

The Union Steam Ship Company of New Zealand, Limited, was established in 1875 for the purpose of taking over the business and plant of the Harbour Steam Company, a small joint stock enterprise, whose operations were originally confined to the trade between Dunedin and Port Chalmers, but were afterwards extended to ports of the Middle Island. The new company took over three small steamers of 460 tons, 146 tons, and 118 tons register respectively, and two others of 720 tons gross register each, which had been ordered from Denny Brothers, of Dumbarton. With these larger steamers the Union Company promptly extended their operations to the North Island, each steamer making a fortnightly trip from Dunedin to Onehunga and back, via Lyttelton, Wellington, Picton, Nelson, and Taranaki. The company was incorporated on 12th July, 1875, with a nominal capital of £250,000, and the policy which the directors adopted at the first was to look ahead and anticipate trade requirements, a policy which it has consistently maintained throughout its prosperous career. The first important addition to its fleet was through the purchase of the four steamers of the New Zealand Steam Shipping Company, a Wellington proprietary which had for some years carried on the coastal trade of the colony. Other steamers were gradually added to cope with the company's growing business, until in November, 1878, an important development took place in the purchase of M'Meckan, Blackwood and Company's intercolonial fleet, which ran a weekly service between Melbourne and New Zealand. This important purchase placed the principal coastal and intercolonial carrying trade in the company's hands. They followed this important accession to their fleet of steamers by ordering a vessel of larger capacity than any they yet owned, and it is worthy of being recorded that the new steamer—the Rotomahana—was the first trading vessel built of mild steel, a material which is now almost universally used in the construction of the finest class of steamships. Owing to the great extension of the company's operations it was at this time (1879) found necessary to increase its nominal capital to £500,000, and a London Board was constituted in the following year. Energy and progress continued to be the watchwords of the Company, and in the course of the next three or four years steamer followed steamer in quick succession from Messrs Denny's yards, while purchases of others were made in the colonies, including several for the development of the South Sea Islands trade, on which the company had embarked. To meet the requirements of a growing intercolonial trade, and to provide for the transhipment work resulting from the inauguration of direct steam services between London and New Zealand, several cargo steamers were added to the fleet during the next few years. In 1885, in conjunction with the Oceanic Steamship Company of San Francisco, the Union Company took up the contract for the carriage of the Home mails via San Francisco, the first trips from the colonies under the new contract being made by the Union Company's splendid new steamer Mararoa, which had just arrived from Home. This contract was carried on by the two companies for a period of 16 years, when on the renewal of the contract, the arrangement between the companies was not continued, the subsidy contributed by the United States Government being confined to American-owned ships, and the contract was taken by the Oceanic Company. In 1885 the Union Company assisted in the development of the West Coast trade by the purchase of the Black Diamond line of five small steamers owned by a Wellington company, and by taking over a small mine at Westport—the steamer Koranui being also included in the purchase of this latter property. Two years later the company made an arrangement with the Westport Coal Company by which the former Company obtained all its supplies of coal from the Westport Company. It took over the Westport Company's three steam colliers, and ordered a further steamer for opening up a trade in coal with Australia. Subsequently the company made a somewhat similar arrangement with the Grey Valley Coal Company, taking over from the owners their three steam colliers. In 1890 the Union Company added four steamers to their fleet, and in 1891 a most important step was taken by the directors in the purchase of the plant and business of the Tasmanian Steam Navigation Company. The property thus acquired consisted of eight steamers, five hulks, freehold premises in Hobart, Launceston, and other ports, and a valuable wharf property in Sydney adjoining the company's own premises, the total amount involved in the purchase being £185,000. This necessitated an increase of the company's capital to £1,000,000, which was duly authorised at an extraordinary meeting held on 13th July, 1891. This large purchase strengthened the company's position as the premier shipping company of the colonies. During the course of the same year four additional steamers were purchased, two of these being specially designed and built for the Fiji trade. The next extension of the company's business was made in 1896, when a regular service was established between New Zealand and the Cook Islands and Tahiti, and in 1901, on ceasing to participate in the San Francisco mail service, the company took an interest in the Vancouver mail service, their splendid new steamer Moana replacing the Warrimoo, which was purchased by them and placed in the ordinary intercolonial running. In 1900 the Monowai, after being withdrawn from the San Francisco service, was employed to transport the South Island portion of the Fourth New Zealand Contingent to South Africa. Year after year the company has continued to add to its fleet vessels of the highest type and of steadily increasing size, and the very latest developments in machinery and in the art of shipbuilding are found in their steamers. At the present time they are building a steamer engined on the turbine principle to run an express service between Launceston and Melbourne. I need only mention the names of the Manuka, Moana, Moeraki, and Mokoia to illustrate the facilities enjoyed by the travelling public now, compared with those at their disposal when the Union Company began business. In 1875 the company commenced its operations with three steamers, the gross tonnage of the largest being 460—to-day its fleet comprises 53 steamers of an aggregate tonnage of 94,250, of which nine range from 2000 to 3000 tons, five from 3000 to 4000 tons, two from 4000 to 5000 tons, and one whose tonnage is 5700. Their services originally embracing a few ports on the New Zealand coast, now spread like a network over the Australasian colonies and South Sea Islands, and extend outside of these as far as India and Canada.

The Westport Colliery Company was established in 1878 for the purpose of working the several leases of coal-bearing land on the West Coast originally acquired by the Hon. R. Oliver, Messrs Haggitt, Fisher, Cable and Drummond, and others, and the first coal was brought to market in August, 1880. The capital of this company proving too small, a new company was formed to take over the property. This second company is the present Westport Coal Company, with a capital of £400,000, in 80,000 shares of £5 each. The company was registered in September, 1881. The company's leases comprise 5430 acres of the Buller Coal Reserve, held from the Crown for a term of 99 years. The celebrated Coalbrookdale seam of coal is worked by this company at two places—namely, Denniston and Granity Creek. The output from these mines from the commencement to 31st December, 1902, was 4,187,548 tons. The annual output now exceeds half a million tons. The company has paid away in wages from its inception £1,192,602; freights, £900,885; royalty, railway haulage, rates and taxes, £657,700; new works, plant, and stores, £404,427. Its annual wage sheet now exceeds £120,000, and it employs upwards of 1000 hands. Although the company's mines are in another part of the colony, it is an Otago company, and with the Union Steam Ship Company takes pride of place as one of the largest corporations associated with the commerce of New Zealand.

Some particulars of the Mosgiel Company will be found in the "Industries" section of this paper.

Among the other leading joint stock companies whose headquarters are in Otago may be enumerated the National Insurance Company of Zealand and the Standard Insurance Company of New Zealand, the former with a paid-up capital of £100,000, and the latter of £75,000.

II. INDUSTRIES.

To deal at all adequately with the varied and important industries carried on in the Otago provincial district would involve far more space than is available for the purpose. There have arisen within the past 40 years great industries that have contributed largely to the marvellous progress that New Zealand has made and to her wonderful vitality and prosperity. It is quite impossible to give to each of these the space that its importance warrants; but in the case of at least one of them—that of Mining—it may be permissible to indulge in a somewhat full summary of its progress, for it is due to the mining industry that Otago rose with astonishing rapidity to a position of great importance and for a number of years outstripped the other provinces in her trade returns. I need not take up much space in references to the wool-growing and agricultural industries of the province beyond setting out clearly the figures which show the developments of these important features of her sturdy and prosperous industrial life. Among the manufacturing industries which give steady employment to a large proportion of our people, first place must be given to the great woollen mills which stand as an enduring monument to the enterprise of their founders. Closely allied to them may be mentioned the clothing factories which employ so many of our people, largely women and girls—a factor which has doubtless had an important bearing on the scarcity of domestic servants. And following in their wake must be brought under hurried review the busy hives of industry represented by the numerous biscuit and jam factories, with the added branches of fruit-preserving and canning, the canning of sheep and ox tongues, fish, and other articles of daily consumption. Then there are the important timber and woodware factories, the foundries and engineering works, the artificial manure works—in which the New Zealand Drug Co., Limited, with a capital of £200,000, takes the lead—the brick and tile works, the tanneries and wool-scouring establishments, and many other smaller industries, which, in the aggregate, represent an enormous investment of capital, and it may be fairly claimed, have made Otago the leading centre of industrial life in the colony.

THE MINING INDUSTRY.

It was in June, 1861, that a Government bonus of £500 offered for the discovery of a payable goldfield in Otago was successfully claimed by Thomas Gabriel Read for a discovery made by him in the Tuapeka district. Shortly afterwards "Gabriel's Gully" became one of the most famous spots in New Zealand, and a tremendous influx of gold-seekers from the other colonies set in. The announcement of really important gold discoveries at Tuapeka and Waitahuna caused no small degree of excitement in the infant settlement of Otago, and every man who could do so went "off to the diggings." Other discoveries speedily followed, and so rich did the goldfield in Gabriel's Gully prove that by August, 1861, the first gold escort brought to Dunedin 5056oz of gold. The excitement became intense, and diggers soon came flocking in from Australia. The gold rush assumed enormous dimensions, and at times the outskirts of Dunedin were white with the diggers' tents, as they pitched their movable camp for the night, en route to the new El Dorado. The population of Otago, estimated at 12,691 persons at the end of 1860, had swelled to 30,269 by the end of the following year. Although many who joined in the first wild rush for the new goldfield left in disgust with their hopes unrealised, yet the gold yield continued to mount up steadily. By the end of 1861 the escort had brought 171,038oz of gold from Lawrence to Dunedin, and the following year no less than

199,547oz of gold were conveyed by the escort to Dunedin. In 1861 the escort returns from Waitahuna were 35,709oz, and for 1862, 48,429oz. The following year there was a marked falling-off in the gold escort both from Lawrence and Waitahuna. Early in 1862 gold was discovered on the Waipori River, which has ever since continued to be an important mining centre. The influx of experienced miners from other goldfields led to systematic prospecting of the interior, and even the least inaccessible places were tested for the precious metal. One of the most important discoveries of this period was made by a couple of Californian miners. In August, 1862, Messrs Hartley and Riley lodged with the Gold Receiver in Dunedin 1047oz of gold, but refused to divulge the locality where the gold was obtained until guaranteed a reward of £2000, conditional upon 16,000oz being brought down by the escort within three months. The conditions having been agreed to the locality was stated to be near the junction of the Molyneux River with the Kawarau. Thousands speedily hastened to the new field, and the banks of the river on either side became occupied by a numerous mining population. In September, 1862, another important discovery was announced to the Government by a party of Victorian miners on the Nokomai River, a tributary of the Mataura. In the following month important discoveries were made in the Dunstan district, and before the close of the year 70,000oz of gold were brought down from the Dunstan goldfield by the escort. About this time a party of three miners won 200oz of gold in eight days from the sands of the Shotover River. A rush followed, and the Shotover yielded a considerable golden harvest to the hardy diggers. The discovery of these goldfields soon augmented the gold returns. The total quantity of gold exported from Dunedin to the end of July, 1862, amounted to 458,488oz. There remained in the hands of the Provincial Treasurer 4787oz—making a total for the year of 463,236oz. For the year ended July 31, 1863, the gold export from Dunedin was 514,385oz. For the first three years and nine months after Gabriel Read's discovery, 1,699,667oz passed through the Customs House at Dunedin. Besides this, 63,790oz had been exported from other ports, making a total of 1,763,637oz, of an estimated value of over seven millions sterling.

Quartz mining has never attained any very considerable proportions in Otago. The principal development has taken place at Macetown and Skippers, on what is supposed to be practically the same line of reef. The Phœnix mine, Skippers, is, or was, one of the best quartz mines in Otago. This mine commenced operations in 1884, and the following year a very complete electric plant was installed for driving a battery of 30 stamps. For several years after this the mine had a very prosperous career; but of recent years the lodes have failed, and further extensive prospecting will be necessary to pick them up again.

At Macetown, the Premier Company operated on a line of reef 3ft in thickness and averaging 16dwt to the ton. For a number of years remunerative results were obtained; but the mine has now ceased operations. In the same locality the Gallant Tipperary Company worked a lode varying in thickness from 2ft to 15ft. During the first nine years the gold won was valued at £53,000. This mine has also ceased operations.

The Cromwell quartz mine at Bendigo for some years proved a remunerative venture. The lodes were worked privately until 1876, and it is estimated that up to that time the proprietors won gold to the value of half a million sterling. In 1876 a mining company was formed, and registered under the Mining Companies Act. From that date to the end of 1883, 26,000oz of gold were obtained from the mine. In September, 1884, the old company was wound up and the new company formed. The mine has not been in operation for some time.

The Achilles mine, Bullendale, Skippers, is another quartz mine from which a considerable quantity of gold was won, but which is now closed down. At Waipori, the O.P.Q. mine has had a varied experience, and in the meantime is closed down. Quartz reefs have also been worked with more or less success at the Head of Lake Wakatipu, at Rough Ridge, Nenthorn, Hindon, Barewood, and in the Tokomairiro district. At Barewood profitable operations are at the present time being carried on.

Much of the sluicing ground left by the early diggers as non-payable has since been put to profitable use by means of ground sluicing and hydraulic elevating. There are a number of important concerns of the latter type, notably that of the Blue Spur Consolidated Company. The latter in its early years carried on its operations mainly in the tailings from the old workings at Blue Spur, when the best of that remarkable deposit was put through the batteries of the several companies that found remunerative employment for many years. The company has since broken down and treated the solid deposits in the hills at the head of the gully, and from the time it was registered in 1888 up till the end of last year the total amount of gold won was 38,930oz, valued at £153,007. The Roxburgh Amalgamated Sluicing Company, registered in March, 1889, has won 18,637oz of gold, valued at £72,398. The Nokomai Hydraulic Company, which was registered in March, 1898, has won gold to the value of £27,872. The Deep Stream Amalgamated Hydraulic Sluicing Company, registered in February, 1897, has won 4557oz of gold, valued at £17,546. The Naseby Dredging and Hydraulic Sluicing Company, registered in October, 1897, up till the end of last year won gold to the value of £10,520. The other principal sluicing properties in Otago are those which have been worked by Mr John Ewing and others in the St. Bathans district, the Round Hill Company's extensive claim near Orepuki, in Southland, and there have been other important sluicing claims successfully worked in various parts of the province—notably at Waikaia, Bannockburn, Marewhenua, Wetherstones, the Teviot district, and Waipori.

Gold dredging has now developed into a very important form of gold mining. During the past 25 years many and varied attempts have been made to secure the gold known to lie thickly strewn in the bed of the Molyneux and some of its chief tributaries. Dredges operated by the river current were at work for about 20 years, but there was no important development of the dredging industry until 1899, when a new form of steam dredge was set to work, not only on the rivers, but on alluvial deposits wherever water could be obtained to keep a dredge afloat. By the end of the year some 30 dredges were at work, and 46,152oz of gold added to the gold returns by the dredges. The dredging returns for 1900 were 62,276oz; for 1901, 65,505oz; and for 1902, 105,786oz. At the end of 1902 there were 211 dredges on the Otago goldfields, and of these 151 were working. In addition, there has been a considerable development of dredging on the West

Coast. Between 1857 and 1890 the total quantity of gold entered for export from Otago was 4,783,955oz, valued at £18,886,878. Up to the end of last year the total amount of gold exported from January 1857 to March 31, 1903, was 6,044,721oz, valued at £23,970,922. from Otago was 6,007,613oz, valued at £23,818,000. Other minerals than gold have been found in Otago. A valuable scheelite lode occurs at the Head of Lake Wakatipu; but distance from market has prevented its profitable working. Scheelite is saved by concentration from a quartz reef at Macraes, and last year 40 tons were exported. Cinnabar has been discovered on the Waitahuna Heights, near Lawrence, but so far prospecting has failed to discover a workable lode. Antimony occurs at Waipori and at Alexandra, but the lodes have not, so far, been turned to profitable account. Valuable discoveries of rock phosphate have been made at Clarendon and Milburn, near Milton, and the rock is being ground for phosphate manure.

COAL MINING.

The only other form of mining of any importance in Otago is coal mining. Only a few of the principal mines need here be referred to. At Shag Point, 40 miles north of Dunedin, good coal occurs, and has been worked since 1862. Until 1879 the coal seams were worked by means of a dip drive into the hill. But the seams having been traced below the sea level, a shaft was put down, and the coal mined for some distance below the ocean floor. Some time ago, while cutting a deeper seam of coal, a large flow of sea water was tapped, and the workings had to be abandoned. Attempts are, however, being made to reopen the mine. Up to the time of its closing down the total output of coal was 401,772 tons. The Allandale mine, near the same locality, has had a total output of 190,358 tons. The most important Otago mine is at Kaitangata. In 1858 coal was worked near the seashore at Coal Point, and in 1864 a mine was opened near the present workings, but nothing was done on a large scale until 1875, when a railway was constructed to connect the mine with the Government railway at Stirling. The principal workings are by means of a dip drive, but there is also a shaft to tap some of the deeper workings. Household coal of excellent quality occurs in considerable quantity, the largest seam being 25ft thick. Faults interfere a great extent with the workings. In February, 1900, the property of the Kaitangata Railway and Coal Company was acquired by the New Zealand Collieries and Oil Company. The total output of the mine, including the company's Castle Hill mine, has been 1,641,257 tons. Near Kaitangata the Taratu Company has opened up a large new seam of coal. A short private line of railway connects with the Government line at Lovell's Flat. Brown coal of fair quality occurs at Fortification, a few miles down the Tokomairiro River from Milton, and extensive deposits of similar coal lie between the Tokomairiro River and Kaitangata. At Green Island, near Dunedin, lignite of good quality has been mined for a great many years. The principal mines are the Walton Park, Fernhill, and Freeman's. The total output of the Walton Park mine to the end of 1902 was 565,818 tons, but the mine is now worked out. The output of Freeman's mine to the same date was 264,566 tons; and of the Fernhill Company, 135,787 tons.

The principal Southland mine is that at Nightcaps, 44 miles from Invercargill. The total output is 338,497 tons.

THE PASTORAL INDUSTRY.

The first record of an export of wool from New Zealand is contained in the following report published in the Hobart Town Courier of January 18, 1839:—"Messrs Ramsay and Young received from New Zealand a small consignment of wool, the produce of these islands. It exceeds, both in length of staple and firmness of texture, any wool ever produced in New South Wales. The beautiful manner in which it was washed and sorted sufficiently explains the superiority of the climate of New Zealand, and forms additional proof in support of the policy of the British Government forming a settlement there to prevent its falling into the hands of the French."

The return of live stock in the province of Otago in December, 1854, gives the number of sheep as 58,902, and the return made to the superintenlent in May, 1855, of "Flocks, dipped or dressed,' gives the names of 17 flock owners, 16 of the 17 flocks being reported as "clean." According to the inspector's report the number of sheep at September, 1860, was in the northern district 302,839, and in the southern district 131,171, or a total of 440,010 for Otago and Southland. In December, 1861, the inspector reported a great addition to the sheep during the year, in Otago alone there being 523,126, adding to which 55 per cent. of lambs (not returnable) gave nearly 1,000,000 sheep in the province. During the next five years the increase does not seem to have been very great, for the inspector reports the number of sheep for the year ended September 30, 1865, as 1,272,135, and that the importations from Australia during the year had been small. Another significant remark was to the effect that there was a considerable decrease in the consumption of mutton, thus indicating the commencement of the difficulty, more or less felt during the next 15 years, of profitably disposing of the carcases of the sheep after the wool and pelts had been marketed.

Following is the numerical strength of the flocks of the province according to the Government returns from 1867 to date:—

1867	...	2,438,260	1897-8	...	4,021,065
1871	...	2,893,814	1898-9	...	3,961,459
1874	...	4,326,988	1899-00	...	3,715,485
1878	...	4,446,855	1900-01	...	3,746,750
1891	...	4,291,464	1901-2	...	3,978,011
1895-6	...	4,365,661	1902-3	...	3,618,776
1896-7	...	3,995,496			

It will thus be seen that the flocks in Otago stood at their highest in 1878, and the decrease is due to the gradual displacement of sheep in favour of dairying—for which the low value of wool during recent years will account,—to the heavy drafts made by Canterbury buyers to secure "prime Canterbury" bred in Otago, and, within the last 12 months, to the excessive exporting of live sheep and frozen mutton, on account of the drought in the Commonwealth of Australia.

From 1865 on till 1880 the problem with flock-owners was what to do with the carcases of the sheep, the supply of mutton being largely in excess of the local consumption. About the year 1867 the meat trade was at such a low ebb that in several instances flocks after being shorn were killed for manure, but the labour of slaughtering the sheep was barely remunerated by the price of the pelts.

It is not possible to detail the various expedients adopted to deal with the surplus mutton. About the year 1869 boiling down works were established, and after being shorn sheep were sold for boiling down at from 1s 6d to 2s per head. From this sprung up a trade in tallow and other by-products which were exported in considerable quantities. An attempt was also made to establish a trade in mutton hams, but this did not develop to any appreciable extent.

The next step in the evolution of the meat industry was the establishment about the year 1870 of meat-preserving works, notably the works at Abbotsford, in which the late Mr E. B. Cargill was largely interested. But these works for a variety of reasons were only partially successful in dealing with the difficulty.

The frozen meat industry, which has had such a far-reaching effect on the prosperity of the province, was inaugurated towards the end of the year 1880. The New Zealand and Australian Land Company entered into negotiations with the old Albion Shipping Company and the Bell-Coleman Company, through whose joint exertions the sailing ship Dunedin was fitted out with a freezer and sent to Port Chalmers to load. Her cargo consisted of 3970 sheep, which were slaughtered on the company's Totara Estate, near Oamaru, sent to Port Chalmers in insulated vans, and frozen on board the ship, the first meat being taken into the freezing room on December 7, 1881. The first cargo of frozen meat shipped from Australasia left Port Chalmers on February 15, 1881. The freight paid was at the rate of 2½d per pound, and the consignment netted 3.37d f.o.b. Dunedin. It was not long before a fleet of properly-equipped steamers took up the trade; freezing works were established at Burnside and at Oamaru, and the following figures for the colony will illustrate the wonderful growth of the important industry, the initiation of which is due to the foresight of Otago business men:—

SUMMARY OF THE FROZEN MEAT EXPORTED FROM THE COLONY FROM THE YEAR 1882.

(Weight in lbs.; figures for Otago alone not being obtainable.)

1882	1,707,328
1883	9,853,200
1884	28,445,228
1885	33,204,976
1886	38,758,160
1887	45,035,984
1888	61,857,376
1889	73,364,064
1890	100,934,756
1891	110,199,082
1892	97,636,557
1893	100,262,453
1894	114,827,216
1895	127,018,864
1896	123,576,544
1897	157,687,152
1898	173,798,576
1899	208,972,624
1900	206,621,072
1901	208,045,264
1902	239,518,384
1903 (6 months) ...	176,977,446

There are nine meat-freezing and preserving works in Otago. The principal of these are at Oamaru, at Burnside, and at Port Chalmers. At Oamaru there are two Bell-Coleman machines and a 60 ton Hercules refrigerator, capable of freezing 1200 sheep a day, with storage room for 20,000 carcases. At Burnside the machinery is capable of freezing 2000 carcases a day, with storage room for 50,000 carcases. The Port Chalmers Freezing Works, erected in 1896 by the Otago Dock Trust at a cost of £4500, is principally used for the storage of rabbits, butter, etc. The Southland Freezing Company's works at Mataura and Bluff are large concerns, and have been of great value to agriculturists in the fertile district they command. They have been large exporters from the Bluff.

In addition to supplying local needs the export of wool from the province is a considerable item, as the following figures will show:—

1898-99— 9,757,597lb, valued at £310,512
1899-00—23,508,204lb, „ £707,707
1900-01—21,227,048lb, „ £800,323
1901-02—23,300,592lb, „ £642,888
1902-03—23,860,360lb, „ £552,414

THE DAIRY INDUSTRY.

From very modest beginnings indeed the dairy industry has grown to a magnitude and position of importance that could hardly have been contemplated by those who were instrumental in its inauguration. In this, as in many other important enterprises, Otago was the pioneer, the first dairy factory for the manufacture of cheese on anything like a large scale having been started at Highcliff, on the Otago Peninsula, in 1871 by Mr John Mathieson. The concern was owned by a small co-operative syndicate, of which Mr Riddell, now factory manager for the Taieri and Peninsula Milk Supply Company, Limited, was a partner. For several years the Highcliff factory was in successful operation, a ready market being found for their produce in Australia, where 1s per pound was obtainable. At that price the output at the factory was sold. One shipment of cheese was lost in the s.s. Tararua, wrecked at

Waipapa Point on April 28, 1881. Eventually it was resolved by the syndicate to launch out in a new direction, and a milk supply company was formed with the object of supplying milk to Dunedin residents. From that company the Taieri and Peninsula Milk Supply Company, one of the largest and most successful butter-making factories in the colony, originated. The Edendale Dairy Factory, founded by the New Zealand and Australian Land Company in 1882, was the first registered dairy factory in New Zealand. Mr J. R. Scott, a well-known produce agent, shipped 50 tons of the factory's first season's output to Queensland, where it was sold at 1s per pound. The New Zealand and Australian Land Company were awarded the Government bonus for the produce of their Edendale Factory, which still occupies a leading place among the dairy factories of the colony. After the potentialities of the country for the production of cheese had been proved by the Edendale Factory, other factories of the kind soon followed. Cheese factories were in operation some years before butter-making on the factory scale was commenced. Messrs J. and R. Cuddie had the honour of starting the first butter factory in the colony at Mosgiel in the year 1888. They were storekeepers, and having to deal with a glut of farmers' butter, for which there was no market, they conceived the idea of buying the milk from the farmers and converting it into butter for export. The farmers did not take kindly to the innovation at first, but in the end found it to their own advantage to support the butter factory. The proprietors exported portion of their butter to Australia, and sent part of it to London. The first shipment realised about 10d per pound. After a time several creameries or skimming stations were established by the Messrs Cuddie to supply cream to their central factory. Expert advice was not available, yet the venture was a success. It speaks well for the character of the work done at the Mosgiel Butter Factory when it is known that Mr David Cuddie, who gained his first experience there, is now Government Dairy Instructor in the North Island. Eventually Messrs Cuddie Brothers sold out to the Taieri and Peninsula Milk Supply Company, which had commenced the manufacture of butter in addition to supplying milk. From the small beginnings referred to above the factory system has developed until the total annual export for the colony is now worth over a million and a-quarter sterling. The exports for the year 1902 were 253,998cwt of butter and 74,746cwt of cheese, or a total value of £1,369,341. New Zealand dairy produce has now an assured place in the markets of the United Kingdom, and although London is still the chief distributing centre, the provincial demand is steadily growing. There are now 37 dairy factory companies in Otago and Southland, and the output for the year 1902-3 was as follows:—Cheese, 2,083,087lb; butter, 1,284,478lb. Of the larger dairy factories the Invercargill Dairy Supply Company has seven associated skimming stations or creameries, the North Otago Co-operative Company 12, and the Taieri and Peninsula Company 40. The latter is a co-operative company, and the output for the year 1901-2 was 1410 tons of butter, in addition to a large volume of milk supplied in Dunedin.

THE WOOLLEN INDUSTRY.

The Mosgiel Woollen Company was the outcome of private enterprise, the late Mr A. J. Burns, a sturdy and enterprising son of the first pastor of the Otago settlement, having been led to embark on the establishing of a woollen mill at Mosgiel in 1871. The Provincial Government had for some years offered a bonus of £1500 to anyone successfully founding the woollen industry, and as the result of a visit to Scotland, Mr Burns succeeded in arranging for the necessary capital. He was joined in the venture by Mr John Smaill, the manager of a woollen mill at Innerleithen, and the plant required for the new industry was shipped at Glasgow on the 22nd January, 1871. In due course it reached its destination, and was erected on the site of Mr Burns's old flour-mill at Mosgiel. In August of the same year steam was got up at the mill for the first time, and on the 5th October the first tweed was produced. A second set of machines was ordered in the following year, the mill was increased to double its size, and machinery for the manufacture of hosiery was also imported. Mr Burns and his partner carried on the business until November, 1873, when the present Mosgiel Company was successfully floated and took over the business. The paid-up capital of the company was £53,000, but this was subsequently increased to £83,457 10s. The company remodelled the mill, erected a new building in brick, and imported additional machinery, and largely increased the volume of its manufactures. In 1879 it took over the Kaikorai Woollen Mill, which had been started as a private venture in 1874, and ran it in conjunction with the Mosgiel mill until January, 1902, when the machinery was removed to Mosgiel. The company also bought a woollen mill at Ashburton in 1889, and ran it for 13 years, when it was disposed of. The Mosgiel company has made steady progress, and since its foundation has turned out altogether tweeds, blankets, rugs, hosiery, and other products to the value of about £2,000,000.

The Mosgiel Company may justly claim to be the pioneer woollen company in the colony, but the industry has developed to an enormous extent throughout New Zealand. In Otago the other mills are those of Ross and Glendining, Limited, at Kaikorai Valley; the North Otago Woollen Company at Oamaru, and the Bruce Woollen Company at Milton. By far the largest of these are the splendid mills of Ross and Glendining, which do a very extensive business.

It is computed that the products of the various mills in Otago run into an aggregate value of £240,000 a year, representing probably double that sum in manufactured clothing and other goods.

Of the other leading industries of Otago the principal are the clothing factories, biscuit, confectionery, and jam factories, woodware factories, rope and twine works, engineering works and foundries, paper mills, lime and cement works, artificial manure works, brick and tile works, hat and cap factories, boot factories, tanneries and fellmongeries, printing offices, sail and tent factories, laundries, and others. According to the census of 1901, there were a total of 809 industries in Otago, as against 516 in 1896 and 541 in 1891. These give employment in the aggregate to 5553 males, and 2331 females—a total of 7884 persons. Even approximate figures giving the annual value of the output of these and the other industries carried on in the provincial district are unobtainable, but giving employment as they do to nearly 8000 work-people, it will be seen that the various manufactures enumerated above play an important part in the industrial life of the community and add largely to the wealth of the colony.

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